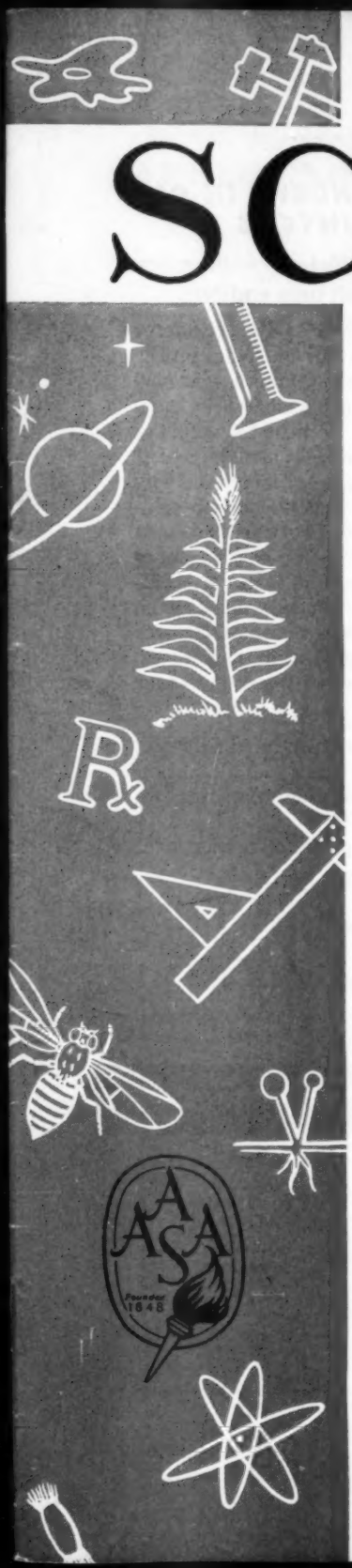

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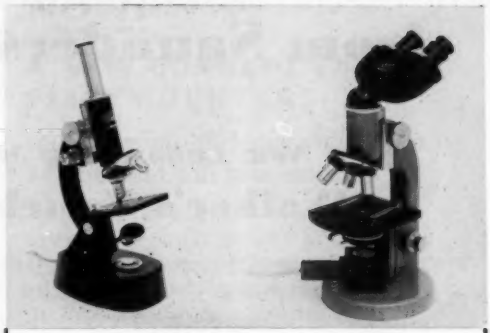

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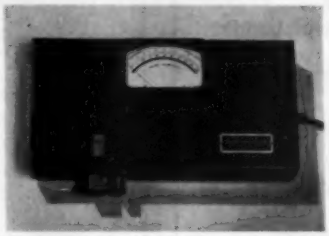

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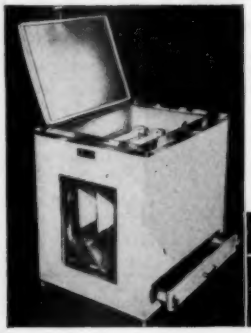

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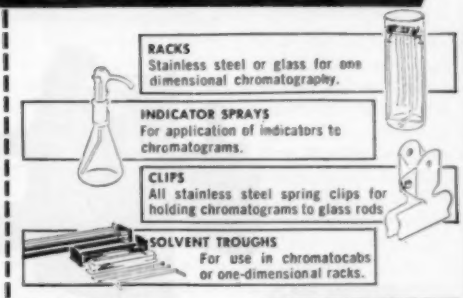
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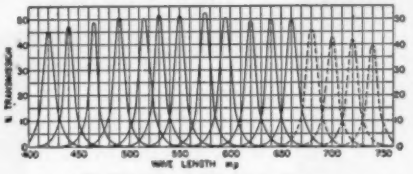

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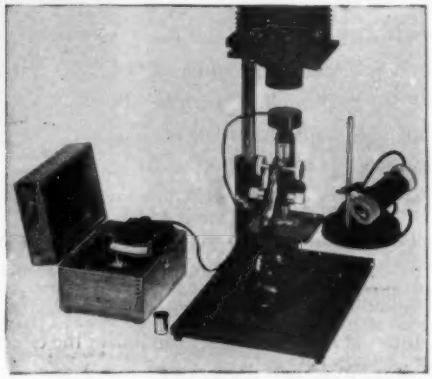

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The Science of Politics

THE recent publication of a five-volume report on *Presidential Nominating Politics in 1952*, prepared under the auspices of the American Political Science Association, affords an appropriate occasion for remarking on the status of the science of politics. It was in a spirit of bravery, if not of bravado, that the American Political Science Association was formed 50 years ago. Scientific research in the field of politics was to be the true hallmark of the profession. But in the intervening years, many other activities have been allowed to pass as political science that are much less strenuous and much less dangerous. The recent project was an attempt, among other things, to bring renewed attention to a central area of professional concern.

The project started modestly enough as an effort to learn something currently about how the delegates to the national political conventions were being selected in the spring of 1952 in about 15 states. A remarkable outpouring and mobilization of voluntary efforts eventually produced reports for all 48 states. These reports covered not only the methods of selection but also the composition of the delegations, their instructions, their voting behavior at the conventions, and what happened to them after they went home.

This observational material has been sifted, organized, edited, surrounded by an apparatus of general reference material on politics in the 48 states, and published in the four regional volumes of the report. Volume I of the report contains historical, analytical, and theoretical approaches to the problem. The report as a whole is probably the most elaborate effort to describe and analyze a complicated phenomenon on a 48-state basis that has ever been completed.

Participants would, nevertheless, be the first to admit that the effort represents no more than an application of rudimentary types of scientific method. The only excuse is the fact that there is no part of the American political system that is more mysterious, more bewildering, or more chaotic. If Ostrogorski's description of the national political conventions, written a half-century ago as an eyewitness account and still widely quoted in the textbooks, is to be regarded as a first approximation, the present effort is not much more than a second. There is need for a third approximation that will get closer to an adequate description of those elements of reality that may be found to have some continuing importance.

As political science moves into its second half-century as an organized profession, it can be hoped that there will be many future projects that will undertake to observe and describe the phenomena of politics and to develop the necessary techniques of classification and analysis. The social sciences have recently been enriched by many advances in methodology that are pertinent to scientific research in politics. What is needed increasingly is some plan or system for the conduct of research in politics that will utilize the more advanced methodologies while also applying them in simultaneous field research throughout the country. This is not an easy goal to achieve, but progress in that direction can be anticipated.

PAUL T. DAVID
Editor-in-Chief
Presidential Nominating Politics in 1952

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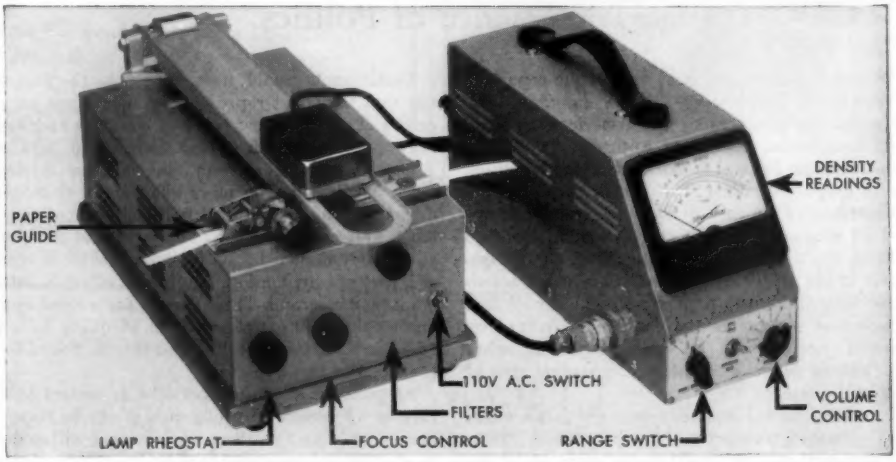

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Chromosomes, Mutations, and Cytoplasm in Maize

Marcus M. Rhoades

Department of Botany, University of Illinois, Urbana

IT seems appropriate here (*1*) to quote the statement made by the late R. A. Emerson at the Sixth International Congress of Genetics in 1932. He said,

> I cannot refrain from noting here a very real advantage experienced by students of maize genetics, which is in no way related to the peculiar characteristics of the maize plant. I am aware of no other group of investigators who have so freely shared with each other not only their materials but even their unpublished data. The present status of maize genetics, whatever of noteworthy significance it presents, is largely to be credited to this somewhat unique, unselfishly cooperative spirit of the considerable group of students of maize genetics.

The Maize Genetics Cooperation was Emerson's creation; its success reflected the high esteem in which he was held. Although maize students no longer are the only group that freely exchanges unpublished information and genetic strains, it was the outstanding success of the Maize Genetics Cooperation that led others to start similar enterprises. It is true that this splendid effort did much to advance the progress of maize genetics, and the spirit that motivated it still prevails today.

Genetic investigations with maize fall into two eras. The first era, which may be said to have ended about 1925, was one in which purely genetic studies dominated; the cytological work was largely concerned with determining the correct chromosome number. Students of maize devoted their efforts to the establishment of a genetic framework upon which the cytogenetical studies of the second era were to be built.

A good deal of experimental work was done with maize prior to the rediscovery of Mendel's laws in 1900. Xenia was described, the vigor of F_1 hybrids of variety crosses was noted, segregation of contrasting characters was reported, and so forth, but no far-reaching conclusions were drawn. Maize genetics truly began in 1900 when De Vries reported the first case of Mendelian inheritance in maize, which involved the sugary locus. This was followed in the next year by Correns' description of the heredity of several endosperm characters, including that of sugary. In the succeeding years, American investigators, notably Collins, Kempton, East, Shull, Emerson, and Hayes, studied the transmission of an ever-increasing number of alternative characteristics, at first chiefly of the more obvious color differences. Emphasis was then rightfully placed upon ascertaining whether heredity in maize conformed to Mendelian principles.

As more and more characters were studied, it was inevitable that linkage would be found. Actually, the first linkage in maize was reported by E. Lewis Sturtevant in 1884 when he described the associated inheritance of the genes for sugary endosperm (*su*) and pod corn (*Tu*), but the true nature of the phenomenon was not recognized. Correns, in 1902, reported aberrant ratios of the starchy-sugary alleles in the F_2 of a cross between a pop and a sugary strain. He mistakenly attributed the deficiency of sugary kernels to selective fertilization. It was later suggested by Emerson that the aberrant ratios were caused by some factor linked with the sugary locus, and in 1926 Mangelsdorf and Jones designated this factor *Ga*. The first unquestionable and clearly recognized linkage in maize was reported in 1911 by Collins and Kempton, who found that the gene for waxy endosperm was linked in its inheritance with a gene for aleurone color, which was shown to be the *C* factor by Bregger in 1918.

One of the most important papers, prior to the advent of cytogenetics, was Emerson's classical analysis of the genetics of plant color in 1921. This paper, possibly more than any other, placed maize genetics on a firm foundation. Other important researches in the second and third decades of this century were the analysis of the complementary interaction of genes in the production of aleurone color by East, Hayes, and Emerson, the demonstration of allelic series at the A_1, *R*, and *P* loci by Emerson and Anderson, the cytological studies by Randolph on the genetically inert supernumerary B chromosomes, the genetic studies of intergeneric *Zea-Euchlaena* hybrids, and the demonstration that pericarp variegation was due to a mutable gene, which was the first proof of such a genetic basis for variegation. Studies of sex expression, of variability in crossing over, of factor interaction, of quantitative inheritance, and of duplicate factor inheritance with its implication of an ancient amphidiploid origin for maize were all fundamental and significant investigations.

There is in maize an astonishing array of gene-controlled characteristics. Mutations have been found that affect every conceivable part of the plant. Nearly 500 mutant genes are listed in the recent compilation by Weijer, which is by no means complete, since many induced and spontaneous mutations have not been cataloged. Since 1902 the linkage relationships of

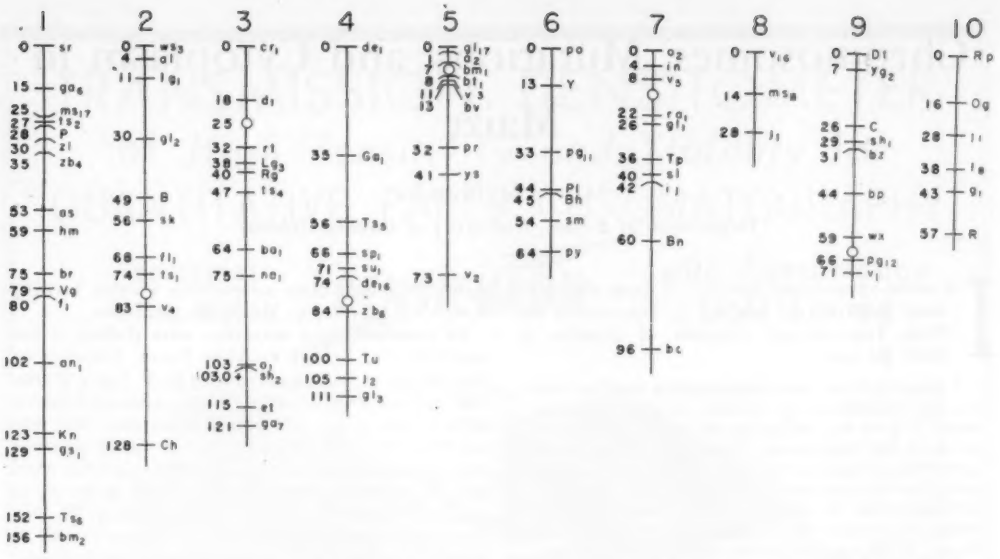

Fig. 1. Linkage maps of maize. The genes in linkage group 1 are carried by chromosome 1, and so forth.

many of these genes have been investigated. These studies culminated in the establishment of ten independent linkage groups, which are shown in Fig. 1. Once this has been done by purely genetic methods, the stage was set for the next great advance, which came with the cytological identification of the chromosomes of the monoploid complement.

In my opinion the second era, marked by the rise of cytogenetics, began with McClintock's study of triploid maize in 1929. The different primary trisomic types derived from this triploid made possible the first correlation of linkage groups with specific chromosomes. Although maize is now considered excellent cytological material, it was not always thus. Prior to the development of the acetocarmine smear technique by Belling in 1921, maize cytologists worked primarily with paraffin sections of root meristems. As can be seen from the polar view of a root tip metaphase (Fig. 2*A*), where little more than chromosome number can be ascertained, maize did not appear to be promising for cytological studies. I recall Emerson relating that Edward Murray East of Harvard, who began his distinguished career as a maize geneticist, decided to forsake corn for *Nicotiana* because maize was in his opinion wholly unsuited for cytological purposes. East's conclusion would be justifiable if nothing better than sections of root tips were available. However, in 1929 McClintock reported that the ten chromosomes could be recognized at the prophase of the first microspore division. The longest member of the haploid complement was designated as chromosome 1, the second longest as chromosome 2, and so forth. The

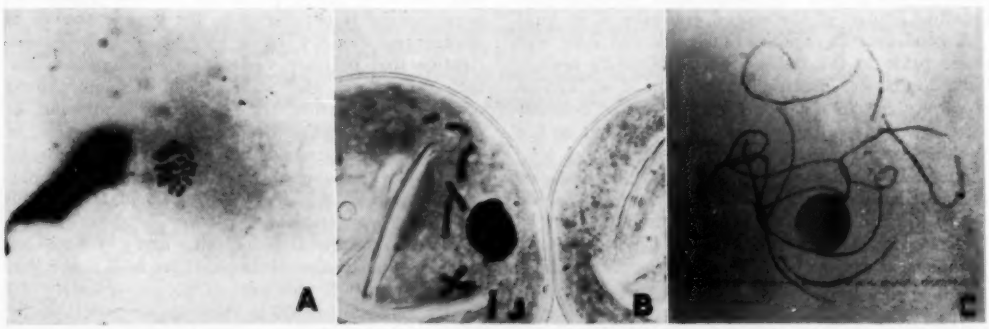

Fig. 2. Chromosome size and morphology in different tissues of the maize plant. (*A*) Polar view of somatic metaphase in root tip. (*B*) Prophase of first microspore division. (*C*) Mid-prophase of first meiotic division [from preparation by D. T. Morgan, Jr.].

microspore chromosomes shown in Fig. 2*B* are more favorable for cytological observations than are those of root tips; but it was from McClintock's later studies of the morphology of the pachytene chromosomes that the great beauty of the maize chromosomes became apparent (Fig. 2*C*). Here the ten chromosomes of the monoploid complement are morphologically distinguishable by (i) their relative lengths, (ii) distinctive chromomere patterns, (iii) deep-staining knobs in characteristic positions, (iv) locations of the centromere (thus determining arm ratios), and (v) the degree of heteropycnosis of the chromomeres adjacent to the centromeres.

The most striking feature of the pachytene chromosomes is the presence of large, deep-staining heteropycnotic knobs. The number of knobs varies greatly in different strains of corn. Knobs have been found in 22 different positions. Some strains have only knobless chromosomes, while in other races a maximum of 16 knobs has been found in a single plant. When a particular knob is present on a certain chromosome, it is a constant feature of the chromosome, and its inheritance is as precise as that of a mutant gene. Knobs are cytological markers in the same sense that mutant genes are genetic markers, and they have been used extensively in cytogenetic experiments. As is diagrammatically illustrated in Fig. 3, one or more knobs may be found on each of the ten chromosomes. Longley, in his extensive study of knob position, found that their locations along the lengths of the chromosomes were not random; there are no knobs in the proximal half of any chromosome arm. Knobs vary in size from those no bigger than prominent chromomeres to ones with a diameter several times that of the pachytene chromosomes. Most knobs are internally located; of the 22 different knob positions, only three are strictly terminal.

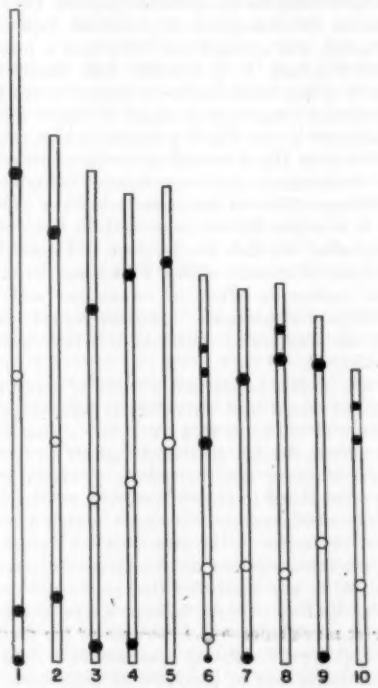

Fig. 3. Diagram of maize chromosomes showing relative lengths, centromeres, and knob positions.

Knobs consist of genetically inert, accessory material. No effect has been associated with them save their role in the formation of neocentromeres at both meiotic anaphases when the abnormal form of chromosome 10 is present (see below). It is improbable, though, that knobs are truly inert; it is more likely that our techniques are too insensitive to detect the part they play in cell metabolism. The largely heteropycnotic supernumerary B chromosomes are also considered to be inert or subinert, and it is significant that Longley found in different races a negative correlation between numbers of knobs and of B chromosomes; that is, strains with many knobbed chromosomes had fewer B chromosomes than did few-knobbed races.

In any consideration of the significance of knobs on maize chromosomes, mention must be made of the hypothesis of Mangelsdorf and Reeves, which holds in part that modern maize originated from an ancient cross between pure knobless maize and a *Tripsacum* species with many terminal knobs. If this is true, all the knobs of modern maize would be of *Tripsacum* origin. Although knobs are genetically inert and would in themselves have no phenotypic effect, it is assumed that segments of genically active chromatin accompanied the knobs when they were transposed to the pure maize chromosomes. It is these remnants of the *Tripsacum* genotype that are held responsible for the tripsacoid features of modern maize. It is, however, somewhat puzzling that we find today no indication of the ancestral rearrangements that were necessary for the transposition of the terminal *Tripsacum* knobs to the interstitial locations they now largely occupy in maize chromosomes.

Although races of maize that have been isolated from one another presumably for hundreds of years exhibit an amazing range in phenotypes owing to genic differences, there is little evidence that gross chromosomal rearrangements have accompanied gene mutations in the evolution of the corn plant. That maize has a stable karyotype is indicated by the failure of both Cooper and Brink and later of Rhoades and Dempsey to find structural changes in their studies of chromosomal homology in exotic races. The only known exception is that of chromosome 10, the shortest member of the complement. There are two kinds of chromosome 10 (Fig. 4). The less frequently found, abnormal kind of chromosome 10 differs from the normal in the chromomere structure of the distal one-sixth of the long arm but more strikingly by having a large, chiefly heteropycnotic segment of chromatin terminally located on the long arm. Inasmuch

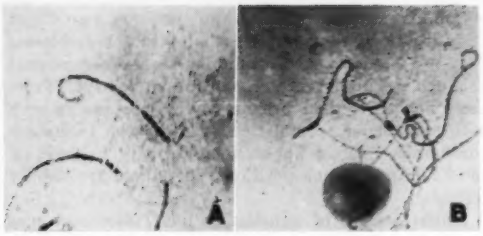

Fig. 4. The two types of chromosome 10 found in races of maize: (*A*) normal type; (*B*) abnormal chromosome 10.

as crossing over is reduced in the distal one-sixth of the long arm in plants heterozygous for abnormal 10, it is probable that this region with dissimilar chromomeres has some kind of structural modification. The lack of homology of the extra segment with regions of other chromosomes is indicated by its failure to synapse with them. Moreover, the exceptional nature of abnormal 10 is demonstrated by its being responsible for preferential segregation and for the formation of neocentromeres.

More surprising than the uniformity of chromosome structure in diverse races of maize is the situation found in hybrids between maize and annual teosinte. Emerson and Beadle found normal crossover values in hybrids between Durango, Chaleo, and Florida strains of teosinte and maize for all tested chromosome segments except the short arm of chromosome 9 in the Florida-maize hybrid. The genetic evidence suggests that these species have few structural differences. In agreement with the genetic data is O'Mara's cytological analysis of pachytene pairing, which indicates that maize and Nojoya teosinte have no detectable cytological rearrangements, while Florida teosinte differs from maize by an inversion in the short arm of chromosome 9. This explains why no crossing over was found in this region in Florida-maize hybrids.

The cytological identification of the individual chromosomes and their correlation with specific linkage groups were the basis for a long series of important cytogenetical studies. Maize cytogenetics was in full flower in the 1930's. Among the many significant investigations were (i) the correlation of cytological and genetical crossing over, (ii) the demonstration of chromatid crossing over by both genetic and cytological methods, (iii) studies of synaptic forces responsible for nonhomologous pairing, (iv) the structure and function of the nucleolar-organizing body on chromosome 6, (v) trisomic and tetraploid inheritance, (vi) cytological and genetic studies of teosinte and *Tripsacum* and of their hybrids with maize, (vii) experimental induction of polyploidy, (viii) analysis of meiotic processes by study of derangements produced by genes such as those for asynapsis, sticky chromosomes, polymitosis, divergent spindle, and so forth, (ix) the relationship between crossing over and chromosome association, and (x) many beautifully executed studies on translocations, deficiencies, inversions, and ring-shaped chromosomes. I realize that it is unfair not to give credit here for the afore-mentioned investigations, but the list would be far too long. Suffice it to say that among those who played a prominent role in these early studies were McClintock above all, Burnham, Stadler, Randolph, Beadle, Longley, Mangelsdorf, Reeves, Brink, Creighton, Cooper, Anderson, and Clark.

It was a fortunate coincidence that Stadler was engaged in his experimental studies on the effects of x-rays in inducing mutations at the same time that McClintock was making her study of the pachytene chromosomes—fortunate for the cytogeneticist, because a great number of chromosomal aberrations were available at the very time mastery of the cytological technique was achieved, and fortunate for the study of induced mutation in that the examination of the pachytene chromosomes permitted a more precise determination of the nature of the induced changes. For example, deficiencies simulating gene mutation, which otherwise would have gone undetected, were now cytologically demonstrable.

Prior to the discovery of the mutagenic effects of short-wave radiations, mutation studies consisted chiefly of work on a highly mutable gene at the *P* locus producing variegated pericarp and of studies on the rate of spontaneous mutation of a few selected loci affecting endosperm characteristics. These loci are especially valuable for mutation studies. Each kernel, as far as the endosperm is concerned, represents an individual, and a single ear comprises a progeny of several hundred. It is possible with relatively little effort to obtain large numbers. Stadler found that the spontaneous frequency of mutation varied widely for the different genes. The *R* gene had a high rate, while the *Wx* gene failed to mutate in his experiments. It was demonstrated that spontaneous mutation rates of different alleles at the same locus vary widely and that it is impossible to characterize a locus as stable or unstable. All that can be done is to compare the mutability of specific alleles. Following the discovery of the mutagenic effects of irradiation with x-rays, the study of spontaneous mutation lagged somewhat while the spectacular effects of this new agent were investigated.

It was at first hoped that a study of x-ray induced mutations would lead ultimately to knowledge of the structure of the gene. However, after a long series of experiments, Stadler concluded that all x-ray induced changes in maize were extragenic in origin and that x-rays had failed to induce mutations similar to those arising spontaneously. Induced mutations having proved ineffective in the attack on the nature of the gene, attention was once more centered on spontaneous mutation. It was concluded that gene mutation could not be studied in experiments where the mutants occur at miscellaneous loci, because of the diverse nature of changes simulating gene mutation. Such extragenic changes may be produced by deficiencies, duplications, small rearrangements, and even by position effects that involve nothing more than a recombination

of genic elements by crossing over. The proper study of gene mutation is concerned with spontaneous changes at specific loci that have favorable characteristics. Two such loci are the *A*, and *R* loci in maize. In mutation studies, it is essential that the rate of spontaneous changes be sufficiently high to afford adequate numbers of mutations for analysis. The A_1 and *R* loci have received more than average attention, not only because they meet this requirement, but also because they have alleles with nonlinear effects.

Let us first consider mutation at the A_1 locus, which is concerned with aleurone, plant, and pericarp color. Of the considerable number of alleles at this locus, there are two that merit brief consideration here. The A^b allele derived from an Ecuadorean race is similar to the standard *A* allele typical of North American races in its aleurone and plant color effects but differs by producing a dominant brown pericarp color. Stadler found that the A^b gene mutated to a new allele, *A*-dilute, which has the dormant brown pericarp effect but whose pale aleurone and red-brown plant colors are recessive to those produced by standard *A*. Laughnan in 1949 demonstrated that the A^b locus was compound, its two component parts, alpha and beta, being separable by crossing over. He showed that, in 92 percent of the mutations of A^b to *A*-dilute, there was a separation of the alpha and beta components by crossing over. The *A*-dilute mutants have only the alpha component. The 8 percent of exceptions where mutation of A^b to *A*-dilute was not accompanied by detectable crossing over has been taken to indicate that mutation of A^b to *A*-dilute can occur without crossing over. Evidence for this conclusion is that mutation to *A*-dilute occurs in heterozygotes where A^b is opposite a deficiency. However, the recent demonstration by Schwartz of sister-strand crossing over gives some support to Laughnan's suggestion that some of these exceptional cases could be due to unequal sister-strand crossing over. It is unlikely, though, that mutation of A^b is invariably associated with crossing over. This is assuredly not so at the *R* locus.

The *R* locus is similar to the A_1 locus in that it affects both aleurone and plant color. Mutations occur in either the aleurone or plant color component, but they are independent events, since never, or rarely, does the same mutational event involve both. Moreover, mutations of one component have no influence on the expression of the nonmutated component. The two components also respond differently to modifying genes. All these facts suggest that the *R* gene is a compound locus—that is, composed of two independent but closely linked genes. However, the finding that the mutation rate of the aleurone color component was substantially reduced following plant color mutation indicated that aleurone and plant color effect were not wholly independent. The question of whether or not the *R* effect was produced by two closely linked genes or by one with dual effects was resolved by the recent report of Stadler and Nuffer that the two components were separable by crossing over. In heterozygotes for certain *R* alleles, crossing over between the two adjacent genes yielded recombination types identical to those produced by gene mutation. It is no doubt significant that both the *A* and *R* loci, which have alleles with nonlinear effects, are compound loci.

That mutation in maize is subject to genic control was demonstrated by the finding that the recessive *a* allele is made highly mutable by the *Dt* gene, although it is stable in the absence of this controller of mutability (Fig. 5). The *Dt* locus is in, or is adjacent to, the heteropycnotic knob terminating the short arm of chromosome 9, while the *a* locus is in chromosome 3. Chromosomal rearrangements are not associated with *Dt*-induced mutations of recessive *a*. Increasing the dosage of *Dt* causes an exponential increase in the number of mutations but does not affect the time at which they occur. Similar in certain respects to the *a-Dt* situation are the results obtained by McClintock in her remarkable analysis of mutable loci involving the Activator-Dissociation complex. Her results can be only briefly mentioned. Both *Ac* and *Ds* are believed to consist of heterochromatin. The nature or state of the *Ds* locus determines the kind of event that will happen at this locus, while the state of *Ac* controls both the time and frequency of these events. Two kinds of events occur at *Ds* loci if *Ac* is present in the nucleus. The chromosome breaks or becomes dissociated into two fragments at the *Ds* locus. Following breakage at the position occupied by *Ds*, fusion of broken ends of sister chromatids may produce a dicentric chromatid and an acentric fragment, or the *Ds* locus may simply drop out, thus producing a normal chromosome deficient for this locus. Which of these two events takes place is determined by the state of *Ds*, while *Ac* is the controller of mutability, since in its absence breaks do not occur at *Ds*. McClintock has found that when *Ds* was transposed next to a dominent allele—and transpositions of both *Ds* and *Ac* are frequent—the normal action of this allele is suppressed and it behaves as a recessive. However, with the loss of *Ds* by means of the breakage mechanism induced by *Ac*, the dominant allele recovers its normal activity. This restoration of normal function simulates a mutation from recessive to dominant, but nothing more is involved than the removal of inhibiting heterochromatin. Not only are McClintock's results of the greatest importance to the problem of mutation, but they also have wide im-

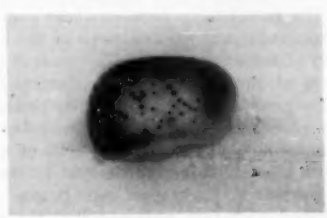

Fig. 5. Maize kernel homozygous for the recessive *a* gene which is made mutable by the *Dt* gene. Each black dot represents a mutation of *a* to a dominant *A* allele.

plications regarding the nature of gene action and the genetic control of differentiation.

Recently, Brink and Nilan, in a reinvestigation of varigated pericarp, reported data which suggest that mutation at the *P* locus involves a mechanism similar to that of *Ac-Ds*, and Peterson from his analysis of a mutable pale green locus concluded that an *Ac*-like factor was operating.

As was true in the study of genes, information on the nature of the cytoplasm and its particulate components can come only when heritable modifications occur whose characteristics can be compared with the normal condition. The chloroplast is a particulate cytoplasmic component that has a high degree of autonomy. Although morphological evidence for chloroplast continuity may be inconclusive, there is good evidence for genetic continuity from breeding experiments.

Plastid mutations not only occur spontaneously but can be induced by the action of specific nuclear genes, as has been demonstrated in two cases in maize. A second type of cytoplasmic change is that responsible for pollen abortion or male sterility. This kind of cytoplasmic mutation has occurred a number of times and is currently of great interest to the hybrid-seed producer, since its utilization promises to make unnecessary the costly and tedious task of detasseling. It is likely that the cytoplasmic condition responsible for male sterility arises from the mutation of a particulate cytoplasmic factor, but this has not yet been fully demonstrated. That interaction of genic and cytoplasmic factors is involved in the expression of the male sterile phenotype became apparent when it was found that certain races carried specific genes that were able to suppress the male sterility factors in the cytoplasm, while other strains had genes that were quite ineffective in this respect. Jones found that some lines had a single dominant gene that would restore pollen fertility. The dissimilar effect of specific fertility-restoring genes on different sources of sterile cytoplasm suggests that these cytoplasmic mutations are not all identical. A complex situation was encountered in the male sterile condition analyzed by Schwartz, where pollen abortion was produced only when a specific kind of cytoplasm was combined with a dominent gene for male sterility and with the recessive allele of a suppressor locus.

Although the amount of work on cytoplasmic inheritance has been negligible compared with that on genes and chromosomes, it may be confidently expected that significant advances will be forthcoming in the future.

Note

1. Presented in the symposium "Species that feed mankind," AAAS meeting Boston, 27 Dec. 1953.

Nuclear Function and Mitosis

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WHEN a cell goes into mitotic division, the state of the nucleus is altered in every visible respect from that which is observed in the cell when it is not dividing (interphase). In interphase, the nucleus is seen as a distinct body, encased in a membrane. The chromosomes exist in a diffuse condition and are seldom resolvable as distinct threads. Often one or more nucleoli are present. In the preparatory stages of mitosis, the nuclear membrane and the nucleoli disappear, and the chromosomes condense into compact bodies of high density. The relationship between these states of the nuclear apparatus and the functions of the nucleus is a question of some importance. The nucleus performs two classes of functions. The reproductive functions include the processes that lead to the production of a new set of chromosomes identical with the original set, guaranteeing that the daughter cells of a division will obtain a complete representation of the genetic material present in the mother cell. It now seems to be established with fair certainty that the syntheses involved in chromosome reproduction take place during interphase and not during the mitotic process itself (*1*).

The class of nuclear functions that may be termed "physiological" includes all nuclear activities that are necessary for the long-term survival of the cell when it is not reproducing. It is reasonably certain that the interphase nucleus performs such functions (*2*).

The question to be considered is whether the physiological activities of the nucleus depend on its being in interphase condition, or whether they can be carried out during division when the chromosomes are condensed and are not separated from the cytoplasm by a membrane.

An experimental attack on this question poses two requirements: (i) an adequate supply of interphase cells and dividing cells for comparison; (ii) a criterion for evaluating the physiological activity of the nucleus. Both of these requirements may be met by choosing the familiar ameba, *Amoeba proteus*, as experimental material.

It has recently been found by T. W. James (*3*), in this laboratory, that members of clones of *A. proteus* will divide quite synchronously if the temperature is cycled. In these experiments, a daily cycle of 12 hr at 18°C and 12 hr at 26°C was employed. At appropriate times (shortly after the beginning of the high-

temperature period), a considerable proportion of the cell population was observed to have entered mitosis, and these could be identified and recovered from the cultures. There was no difficulty in obtaining sufficient numbers of dividing cells for the experiments (*4*) described in this paper. Details of the culture system will be published elsewhere, but it should be noted that a similar principle has been applied recently by Scherbaum and Zeuthen (*5*) in obtaining synchronously dividing populations of *Tetrahymena*.

The criterion of nuclear function applied in this investigation was the magnitude of the incorporation of phosphate, measured as P^{32}, into cell constituents. The effect of the nucleus on this group of processes was discovered by Mazia and Hirshfield (*6*) and has been confirmed and extended by Brachet and coworkers (*7*). It has been shown that within the first hours after removal of the nucleus from *A. proteus*, the amount of P^{32} incorporated in a given time has dropped to 30 to 50 percent of that taken up by normal cells under the same conditions. Other studies on *A. proteus* have shown that, during the same time interval, the respiration (*8*), the level of a number of enzymes (*9–11*), the permeability to water (*12*), and the uptake of neutral red (*13*) seem to be indifferent to the presence or absence of the nucleus. Thus, while the significance of the relationship between the nucleus and phosphate incorporation is not understood, it will serve the purpose of a criterion of nuclear activity. The question we ask is simply: Does the phosphate incorporation of the ameba during division resemble that of an interphase ameba with a nucleus or of an interphase ameba without a nucleus?

The experimental procedure was as follows. The control sample consisted of 25 nondividing amebas isolated from a population that was in the latter half of the interphase period, when the cells had passed the stage of maximum growth. An equal number of amebas at "prophase" was selected for comparison with the nondividing group. The criterions of "prophase" were the rounding up of the organism, the absence of a distinct nucleus, and the absence of a division furrow. The two groups of amebas were placed in an inorganic medium, free from food organisms, to which $P^{32}O^4$ had been added as sodium salts to a final activity of 20 μc/ml. After 20 min exposure at 21°C, the cells were washed repeatedly with nonradioactive medium until the fluid showed no detectable radioactivity. The amebas were then mounted in sample pans, dried, and assayed for P^{32} with the aid of a windowless Geiger counter.

The results are given in Table 1. It will be noted that a number of the cells divided during the experiment. This fact shows, on the one hand, that the exposure to the radioactive medium was harmless but, on the other hand, it signifies that some of the dividing amebas were probably at a later stage than others when selected.

It is evident that the P^{32} incorporation by the dividing amebas is only about one-half of that of the interphase amebas. In a general way, therefore, it may be concluded that when an ameba enters division, the P^{32} uptake is more comparable to that of an interphase cell without a nucleus than to that of one with a nucleus. If the level of P^{32} incorporation is in fact a criterion of the physiological functioning of the nucleus as defined earlier in this paper, it is to be concluded that the nuclear functions are absent or survive at a very depressed level during mitosis.

There is an apparent quantitative difference between the relative levels of P^{32} incorporation in dividing cells and in cells without nuclei when both are compared with nucleated interphase cells. Entry into division lowers the level by a factor of 2, while the earlier data of Mazia and Hirshfield indicated that the removal of the nucleus lowered it by a factor of 3. The discrepancy could signify a residue of nuclear activity during division. However, the values for the dividing cells could easily be too high, because the length of exposure to the isotope was such that some of the dividing cells may have reconstituted their nuclei during the experiment. The data on the number of cells actually observed to complete their division before the end of the experiment suggest that this source of error exists. Likewise, the control levels could have been low compared with those in the earlier experiments, because only "late" interphase cells were chosen in the present case.

The depression of an activity of the cell during division is not in itself unexpected. Zeuthen (*14*) describes experiments on dividing sea urchin eggs which show a brief depression of phosphate uptake during each division. Zeuthen (*14*) also observes, in *Tetrahymena*, that the rate of respiration, which increases in a linear fashion during interphase, levels off during division.

The present work tends to relate cases of depressed cell activity during division to the absence of nuclear functions. If our results permit generalization, it is predicted that any nucleus-dependent operation of the cell will drop to a lower level during division and, conversely, that such a decline will be indicative of participation of the nucleus. In these terms, Zeuthen's observation that respiration in *Tetrahymena* does not decline during division, but that the synthesis of respiratory machinery ceases, is quite reasonable in view of the postulated role of the nucleus in specific biosyntheses (*2*).

Table 1. Comparison of P^{32} incorporation into *Amoeba proteus* at interphase and during mitosis.

Expt. No.	Counts/min per cell		Ratio (interphase/dividing)	Divisions completed during exposure
	Interphase	Dividing		
1	2.3	1.3	1.8	4 of 23
2	2.1	1.2	1.7	1 of 20
3	2.7	1.7	1.6	6 of 25
4	2.7	1.5	1.8	7 of 25
5	2.0	1.1	1.8	4 of 25
6	1.9	1.0	1.9	8 of 25
Avg.	2.3	1.3	1.8	

It seems probable that physiological activities of the nucleus on which the cell depends for long-term normal function depend somehow on the conditions existing in the interphase nucleus. It is not difficult to propose reasons why this should be the case. First, it is quite conceivable that the condensed condition of the chromosomes during division is incompatible with their functioning. Perhaps it would be more proper to say that the highly dispersed condition during interphase is more compatible with the essentially two-dimensional "template" functions that are currently the subject of so much interest (*15, 16*). Second, the hypothesis that the specific functions of the chromosomes depend on their being provided with an appropriate intranuclear environment (*17*) would lead one to predict important alterations in chromosomal function during division, when the nuclear membrane is altered or absent. Finally, and on a somewhat different level, the disappearance of the nucleolus during division should be noted. There is now excellent evidence that the nucleolus is an important center of nuclear function (*18*). If this structure, as has been proposed, mediates in the action of the chromosome on the cytoplasm, it is only to be expected that such action will not be observed in the dividing cell where it is absent.

The present experiments obviously do not favor any one of these alternatives or even limit the possibilities to these three. They do, however, tend to prove what has been suspected: that the contributions of the nucleus to cell function depend on the conditions characteristic of its state when it is not dividing and that the condensed thread so useful to the cytologist is a very poor model for a working chromosome.

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Fungitoxicity of Ethylenethiourea Derivatives

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THE ability to predict fungitoxicity of compounds has been, and continues to be, an elusive but much desired goal. Clues to structural changes that appear to increase activity are many. It is only seldom, however, that a suggested change, based on rationale, results in the creation of a fungitoxic molecule from a configuration that is completely inactive. This is a report of one such case (*1*).

The inactive compound chosen for modification was ethylenethiourea. This heterocylic nitrogen compound is similar in structure to the imidazolines and pyrazoles, derivatives of which have been found to be very fungitoxic (*2, 3*). In addition, ethylenethiourea contains a thioketone group that is present in many fungicides, particularly the derivatives of dithiocarbamic acid. Ethylenethiourea, therefore, appears to have many of the requirements of a fungitoxic compound; yet, it is inactive when tested for fungitoxicity by the depression slide technique (*4*).

A second reason for interest in ethylenethiourea is that it has been identified (*5*) as one of the breakdown products of nabam (disodium ethylenebisdithiocarbamate). Because of its lack of fungitoxicity, it was thought, however, that this compound could not be directly involved in the fungitoxicity of nabam. Could it be, however, that ethylenethiourea is unable to penetrate through the semipermeable membrane of the spore to the site of action? It is possible that nabam, or one of its intermediate break-down products, penetrates readily, decomposing inside to release ethylenethiourea *in situ*. If this were so, then ethylenethiourea itself could exert fungitoxicity if it were changed in such a way as to increase penetration to the site of action within the spore.

One of the simpler methods of increasing penetration is the addition of a hydrocarbon substituent to the molecule (*6*). This possibility was examined by measuring the fungitoxicity of some alkyl-substituted derivatives of ethylenethiourea (*7*). These were propylenethiourea, N,N′-di-n-butylethylenethiourea, N-n-octylethylenethiourea, N-t-octylethylenethiourea,

Table 1. Fungitoxicity data for ethylenethiourea and certain of its homologs. Data given as percentage inhibition of spore germination at various dosages (μ/cm^2).

Compound	*S. sarcinaeforme*				*M. fructicola*			
	1300	130	13	1.3	1300	130	13	1.3
Ethylenethiourea	0	0	0	0	0	0	0	0
Propylenethiourea	92	0	0	0	100	17	0	0
N,N′-di-n-butylethylenethiourea	54	0	0	0	100	100	5	0
N-n-octylethylenethiourea	100	100	0	0	100	100	100	0
N-t-octylethylenethiourea	0	0	0	0	0	0	0	0
N-n-octadecylethylenethiourea	100	57	0	0	100	100	0	0

and N-n-octadecylethylenethiourea. Fungitoxicity to spores of *Stemphylium sarcinaeforme* (Cav.) Wilts. and *Monilinia fructicola* (Wint.) Honey was determined by using the depression-slide dilution technique.

The data are given in Table 1. Against *S. sarcinaeforme,* propylenethiourea and the N,N′-di-n-butyl derivative were weakly toxic. N-n-octylethylenethiourea was the most toxic of the series (*8*). The N-n-octadecyl derivative was less toxic than the N-n-octyl derivative, while N-t-octylethylenethiourea was completely nontoxic. The derivatives fungitoxic to *S. sarcinaeforme* were even more active against *M. fructicola.* The order of toxicity to *M. fructicola,* however, was about the same as for *S. sarcinaeforme.* The only change in rank was in the case of N,N′-di-n-butylethylenethiourea, which was very weakly fungitoxic to *S. sarcinaeforme* but was second most active against *M. fructicola.*

Concerning the fungitoxicity of these compounds, certain points are apparent. Ethylenethiourea can be made into a fungitoxic compound by the addition of an alkyl side chain. As in the case of imidazoline homologs (*2*), fungitoxicity increases with the length of the carbon chain to a certain point and then diminishes as the chain becomes longer. The side chain must be normal to achieve its effect, as was previously found (*9*) for the fungitoxicity of a series of thiophene derivatives. The fungitoxic derivatives are distinctly more active against *M. fructicola* than they are against *S. sarcinaeforme,* which is what Horsfall found for the action of compounds with lipophilic substituents on these fungi (*10*). Miller, McCallan, and Weed (*11*) showed that spores of *M. fructicola* accumulate more (1380 ppm) at a single dosage of a lipophilic material (2-heptadecyl-2-imidazoline) than do the spores of *S. sarcinaeforme* (860 ppm).

From these data, can it be deduced that ethylenethiourea may be directly involved in the fungitoxicity of nabam? Two points argue against it. First, the homologs of ethylenethiourea are definitely more toxic to *M. fructicola* than they are to *S. sacinaeforme,* the reverse of nabam (*12*). Second, the toxicity of these compounds does not approach that of nabam. These differences may arise from the fact that nabam is a water-soluble compound that ionizes and hydrolyzes readily. Hence, its ability to permeate into spores would be quite different from that of the fungitoxic derivatives of ethylenethiourea. The apparent discrepancies certainly do not negate the evidence that ethylenethiourea does indeed possess inherent fungitoxicity. This being so, it is entirely possible that ethylenethiourea released *in situ* may be involved directly in the fungitoxicity of nabam.

It is significant that so many different clues have been found to explain the fungitoxicity of nabam (*5, 13–15*). This points to the possibility that nabam may owe its effectiveness to its versatility as a poison or as a source of poisons. If nabam, or its subsequent break-down products, is able to inhibit or destroy many different life-processes, it is much more likely to block alternative vital mechanisms. This would allow fungi and their spores fewer chances for survival.

References and Notes

1. This research was conducted in cooperation with the Crop Protection Institute.
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News and Notes

Anatomical Terminology

A long chapter of international cooperation is nearing completion by the anatomists of the world, who have been working for several decades toward modernization of the nomenclature of human anatomy. The first concerted effort to create a standard terminology was the *Basel Nomina Anatomica* of 1895, prepared by a learned group of German anatomists with some international help. This was promptly adopted in many countries, including the U.S.A. In Britain however it was never fully established, and in France and other Latin-language countries it was scarcely used at all.

In 1933 the Anatomical Society of Great Britain and Ireland brought out a revision of the *BNA* in English (BR), which included many improvements. At about the same time a German commission prepared the *Jena Nomina Anatomica* (*JNA*). This list was very radical with respect to the terms indicating directions and positions, abandoning the conventional "anatomical position" so that the terms would apply to animals and embryos with reference only to internal coordinates. It spoke only of *cranial* and *caudal, ventral* and *dorsal* instead of *superior* and *inferior, anterior* and *posterior*; it referred, for example, to the maxillary and mandibular lips. However, many of its individual alterations were admirable.

The American Association of Anatomists, which was invited to adhere to each of these proposals, chose to move slowly in the hope of ultimate international action. Its committee put a great deal of work into the preparation of its own (unpublished) list in anticipation of discussion at a congress in 1940. This meeting was prevented by World War II, and for the time nothing could be done. Meanwhile the *BNA* was continued in use in the U.S.A.

By 1950, when a congress was held at Oxford, the situation was clearer. German, Scandinavian, and Dutch anatomists who had used the Jena system were dissatisfied with it. The American-Canadian committee had concluded, after much work and reflection, that a moderate revision of the *BNA* was desirable; and the British, finding that their vernacular modification of the *BNA* was working rather well, were eager to join in an international revision. The congress therefore directed its president, Le Gros Clark, to set up a 30-member international committee. From this a smaller working group was drawn, consisting of Ara (Buenos Aires), Beau (Nancy), Beccari (Florence), Ingelmark (Gothenburg), Stark (Frankfort), Woerdeman (Amsterdam), Johnston (London, secretary), and Corner (Baltimore, chairman). A request for Russian participation sent through diplomatic channels was not even acknowledged.

Meeting in London in 1952 under UNESCO auspices, with the generous hospitality of the Ciba Foundation, this group agreed completely on general principles. It apportioned the preliminary work of revision to seven subcommittees made up of 23 anatomists in 10 countries. Four of these men were in the U.S.A., namely, Boyden, Sam L. Clark, Corner, and Greulich, all of whom are members of the American standing committee. The drafts thus prepared were reviewed, coordinated, and edited at a second meeting of the same group held in London, 1–5 June 1954. Ogawa of Tokyo also came to this meeting, bringing with him a thoughtful memorandum from Japanese colleagues. With remarkable good will and unanimity, the committee adopted a final draft for submission to the next congress, which is to take place in Paris 25–30 July 1955.

This document fulfills the directive to create a moderate revision of the *BNA*, and it has become increasingly evident that such action is the only kind that could win general acceptance. Because anatomists everywhere have had time to study and test the various competing proposals, their views have been converging more than anyone realized. Thus, the London committee holds strong hope that its work will be favorably received. Of course, not everyone will be satisfied with every detail; neither the human body nor human language is logically constructed, and many preferences have to be overruled and some compromises must be made.

Because the problem is so largely one of detail, it is difficult to give in limited space an idea of what has actually been proposed by the committee. The terminology is in Latin as before, because it is still the most useful international language for scientific purposes. The committee realizes, however, that the various vernaculars will be more and more frequently used and, wherever possible, it chose from competing terms the one that is most generally translatable into modern languages. On moot questions of spelling, gender, and so forth, the committee has usually chosen to accept established usage rather than to make pedantic corrections. It is, however, difficult to be consistent in these matters, because Latin itself during its long span as a living language has developed variable usages.

The terms of relative position follow in general the *BNA* usage; but the words *ventral* and *dorsal* are used of the spinal nerve-roots and in some other places where usage has established them. Many generally accepted specific changes are adopted, for example *submandibularis* in place of *BNA submaxillaris* for the gland and its cognominal structures, *rectalis* for *BNA haemorrhoidalis*, of the arteries. Structures discovered or explained since 1895 have been added, notably the carotid sinus and the parathyroid glands. The terminology of certain regions of newly acquired importance has been expanded; the segments of the lung and the corresponding bronchi have been recognized following the ideas of Jackson-Huber and the International Thoracic Surgeons' list. Some of the more fanciful

names of cerebellar lobules have been deleted. Important internal structures of the sense organs on the borderline between gross and microscopic anatomy have been admitted. A list of major cerebral and spinal nerve tracts is provided. The glands of internal secretion are grouped together, and the major subdivisions of the hypophysis named. The spleen is placed at the end of the section on "Angiology."

Eponymic titles, which the makers of *BNA* had to retain for optional use, are unanimously excluded by the London committee. Even the Wolffian and Muellerian ducts appear only under informative names (*Ductus mesonephricus, paramesonephricus*).

As happened with the *BNA* 50 yr ago, the committee's desire to avoid all use of alternative terms could, for various reasons, not be fulfilled. For example, the instructive term *Lamina visceralis pericardii* cannot altogether replace *Epicardium*; both are retained as synonyms. Inflexible national preferences required retention of the time-honored *BNA peroneus* for the muscles originating on the fibula, along with the more informative term *fibularis*, which was favored by half of the committee. A dozen or more such pairs of synonyms were allowed for the sake of the larger agreement.

Every effort will be made to get the committee's draft printed before the April 1955 meeting of the American Association of Anatomists. Meanwhile the undersigned will answer inquiries from those who are interested in particular items.

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Science News

Clinical studies with an ultrasonic device at Columbia University's School of Dental and Oral Surgery give promise of widespread acceptance of an entirely new kind of **tooth drilling technique** that may ultimately affect the practice, the teaching, and even the economics of dentistry. It may also be one answer to the long search for a painless and vibrationless dental drill. The studies, described in a preliminary report in the July issue of the *New York State Dental Journal*, indicate that the new tool is also quicker, quieter, more maneuverable, and far more adaptable than the dental bur.

The new instrument, known as the Cavitron, is an application to dentistry of a machine tool widely used by industry for precision cutting of metals, hard minerals, and other difficult-to-work materials. It has been developed by the Cavitron Equipment Corp., Long Island City, N.Y., which began experiments on extracted teeth in 1947. The first clinical investigations were undertaken in 1952 at Columbia. Subsequently the U.S. Navy and the Royal Air Force in England conducted preliminary work. The pioneering Columbia project has been carried out by Carl R. Oman, professor of dentistry, and a colleague, Edmund Applebaum. Their report is the first concerning the use of the new process on human subjects.

In engineering terms, the Cavitron process makes use of a tool that vibrates with a frequency of 29,000 cy/sec and in turn sets up vibrations in a special cutting solution. The tool contains a ferromagnetic metal that, activated by an alternating magnetic field, expands and contracts; this vibratory motion is transmitted to the rest of the tool and thereby to the cutting liquid.

Damage to vegetation by smog, estimated to exceed $500,000 yearly in Southern California, may be identified by simple test, if preliminary findings of Stanford Research Institute are substantiated. In a paper to appear in a forthcoming issue of *Science*, J. P. Nielsen, H. M. Benedict, and A. J. Holloman, of the Institute's Air Research Laboratories, report the use of techniques involving ultraviolet light to observe the characteristic bright pale blue fluorescence of lesions and other markings on smog-damaged plants. The fluorescence has been definitely associated with leaf damage through experiments with plants exposed to actual smog, to synthetic atmospheres, and to a variety of cultural conditions.

The continued alarming decline of the population of the Atlantic **walrus** despite the abolition of commercial hunting by white men will be the subject of a paper by M. J. Dunbar, chairman of the board of governors, Arctic Institute of North America, to be presented at the annual meeting of the Danish Nature Conservancy. This symposium, scheduled for August in Copenhagen, will consider various problems relating to arctic flora and fauna. Dr. Dunbar, who is also associate professor of zoology at McGill University, departed on 10 July for zoological studies in the Hudson Bay area; his paper, which represents the contribution of the Arctic Institute to the Conservancy proceedings, will be read in his absence.

Although walrus hunting as far south as the Gulf of St. Lawrence was common practice as recently as 200 yr ago, the range of the Atlantic walrus is now sharply limited to areas north of Hudson Bay and Hudson Strait. While citing recent studies indicating that we are now at the height of a 400-yr climatic "amelioration," Dr. Dunbar nevertheless does not ascribe the decrease in walrus to the progressive warming of the North Atlantic, but to the depredations of commercial hunting prior to 1950 and to present Eskimo hunting methods; these last he describes as rivaling the fairy-tale hunters of "Peter and the Wolf," "coming through the forest and shooting as they come." The resultant loss in walrus is not known, but loss of seal under similar hunting methods is estimated at three animals lost for every one landed.

In view of the importance of walrus conservation to the rehabilitation of the Eskimo economy in Canada, steps are being taken by the Department of Northern Affairs to supervise and control the Eskimos' annual walrus kill. However, Dr. Dunbar points out, it is

necessary to know considerably more about the biology of the walrus before the yearly take can be rationally controlled, and this study has now been started by the Fisheries Research Board of Canada. Migratory habits are especially worthy of study, he says, because of indications that the Hudson Bay and Hudson Strait animals may be parts of a large population which joins the walrus of West Greenland for an annual winter migration to the neighborhood of the ice edge in Davis Strait. Dunbar suggests that winter spotting from aircraft might assist in settling this question of a possible connection between the Canadian and Greenland walrus population, with all the economic ramifications involved for the native peoples of both areas.

David M. Greenberg, chairman of the University of California's department of physiological chemistry, and his Egyptian associate, Mostafa S. Mohammed, have been studying the effect on cancer tissue of arginase, an enzyme that plays an important part in the utilization of nitrogen by the body. Some of the **arginase,** which they extracted from horse liver, had a curious blue-green color, an indication of the presence of an impurity. But upon finally crystallizing the supposed impurity, the investigators found that they had isolated a new, copper-containing liver protein, the function of which is unknown.

On 30 June, the **UNESCO Science Cooperation Office** for South East Asia, Manila Branch, was discontinued. The work for the Pacific area will be carried on from the mian office for South East Asia at Djalan Diponegoro 76, Djakarta, Indonesia. Jan Smič, scientific director in charge of the Manila branch, will join Alexander Wolsky in the Djakarta office.

A **new comet** near the constellation of Virgo was discovered on 29 June by Leslie C. Peltier of Delphos, Ohio, an amateur astronomer, and a day later by L. Kresak and M. Vozarova, both of Skalnate Pleso Observatory in Czechoslovakia. The comet is of the ninth magnitude, therefore too faint to be seen without a telescope. Its motion is south-southwest, according to the Harvard College Observatory.

Frank M. Strong and E. D. Schilling, biochemists at the University of Wisconsin, recently identified and isolated a substance from common sweet pea seeds that causes the deforming disease known as **lathyrism.**

The Atomic Energy Commission has announced that **stable isotopes** produced in the Commission's facilities are now available for foreign distribution. Radioisotopes have been sold abroad since 1947, but stable isotopes generally have been released only to users within the U.S. About 175 stable isotopes of nearly 50 elements are produced by the AEC.

Forty-eight countries have been authorized to receive AEC produced radioisotopes and approximately 2500 foreign shipments have been made. The terms and conditions for obtaining stable isotopes will be the same as those that now apply to foreign requests for radioisotopes. The applicant must agree to use the isotope only for the purpose stated in the application and to report research results to the AEC.

Interest in **Interlingua** as a means of scientific communication has resulted in students of Christ Church College in Kanpur, India, organizing a campaign for the support of this international language. L. Singh, professor of physics at Kanpur, has reported that more than one-fifth of the 1500 students of the college have contributed to a fund to help finance wider use of the language. No student was allowed to contribute more than the equivalent of 5 ct in American money.

Interlingua came to the attention of the college in India through the receipt of *Spectroscopia Molecular,* the first scientific journal to be published in the language, of which Forrest F. Cleveland, professor of physics at Illinois Institute of Technology, is editor. The development of Interlingua has been undertaken by a division of Science Service headed by Alexander Gode at 80 E. 11 St., New York.

A 100-mi-long canal system paralleling the Euphrates River in **ancient Mesopotamia** has been uncovered after having been hidden by desert sands for 6000 yr. The find was announced by Albrecht Goetze, a professor at Yale University and also director of the Baghdad School of the American Schools of Oriental Research. The canals, discovered during an expedition to Iraq headed by Thorkild Jacobsen of the University of Chicago's Oriental Institute, furnished water for cultivated areas that supported the Mesopotamian civilization of 4000 to 5000 B.C. The canals also were used for navigation between towns.

Scientists in the News

Karl von Frisch, professor of zoology at Munich University, has recently been elected to the Royal Society (London). Dr. von Frisch is well known for his work on the sense organs of insects and fishes—notably, on how bees exchange information on feeding-places and on their manner of orientation in flight.

At Harvard University, **Eric Lindemann,** associate professor of psychiatry, has been appointed professor of psychiatry in the medical school and psychiatrist-in-chief at Massachusetts General Hospital; and **Raymond DeLacy Adams,** associate clinical professor of neurology has been named Bullard professor of neuropathology in the medical school and continues as chief of the Neurological Service of the Massachusetts General Hospital. The appointments create a new professorship in psychiatry in the Faculty of Medicine and fill two posts vacated by **Stanley Cobb,** who has retired as Bullard professor of neuropathology and as chief of the Psychiatry Service at the Massachusetts General Hospital.

New head of the mathematics department at Washington University, St. Louis, is **Holbrook M. MacNeille,** who has been executive director of the American Mathematical Society since 1949.

Rev. James B. Macelwane, S.J., dean of the Institute of Technology, Saint Louis University, has been designated by the State Department as chief of the U.S. official voting delegation to the International Union of Geodesy and Geophysics, which will hold its 10th General Assembly in Rome, 14–25 Sept.

The other eight voting delegates are Leason H. Adams, Carnegie Institution; J. A. Bjerknes, University of California; Walter H. Bucker, Columbia University; Beno Gutenberg, California Institute of Technology; Joseph Kaplan, University of California in Los Angeles; Walter D. Lambert, Ohio State University; and F. W. Reicheldefer, chief, U.S. Weather Bureau.

Three members of the University of California Medical Center, San Francisco, retired 1 July.

Karl F. Meyer, a leader in infectious disease research and director of the Hooper Foundation, completed 41 yr of service. Before going to California, he spent 2 yr in Transvaal, South Africa, and 3 yr at the University of Pennsylvania. He was born and educated in Switzerland. Dr. Meyer always worked vigorously to translate his laboratory results into usable public health measures. He is credited with the development of methods for controlling botulism.

Robert Wartenberg retired as clinical professor of neurology after 18 yr of service. He was educated at the universities of Rostock and Freiburg, and became a member of the faculty of the latter institution in 1919. He went to California in 1936.

Michael Hobmaier, associate professor of comparative pathology, joined the Hooper Foundation in 1930. Born and educated in Germany, he formerly held posts at the universities of Munich, Berlin, and Dorpat.

W. T. Payne of the physics department at Michigan State College has been appointed associate professor of physics at Hofstra College, effective 1 Sept.

The Endocrine Society has announced the presentation of the Ciba award of 1954 to **Isador Nathan Rosenberg** of New England Center Hospital, Boston, and Tufts College Medical School. This award, which was established in 1942 and provides research support, is given annually to an investigator, not more than 35 yr of age, in recognition of outstanding contributions to clinical or preclinical endocrinology.

Oldest of 9000 Parke, Davis & Co. employees in point of active service, **George S. Sherman** retired 30 June after spending 53 yr with the firm. He joined the organization as a messenger when he was 14 yr old, and for the past 40 yr has handled the makeup of all Parke-Davis catalogs. The company has had seven presidents since its establishment in 1866, and he has served under six of them.

Noel Hudson Stearn, vice president of W. C. McBride, Inc., St. Louis, is retiring to California where his address will be 128 Goya Rd., Menlo Park, after 1 Aug. Dr. Stearn took his M.A. at Stanford in 1918, and his Ph.D. at the University of Wisconsin in 1926 after having served in World War I. He joined McBride that same year on a special geophysical research assignment in connection with the development of the Hotchkiss Superdip magnetometer. In 1930 he was made chief geologist, in 1940 vice president in charge of exploration, and in 1950 comanager of the company.

Conrad P. Straub, a senior sanitary engineer of the U.S. Public Health Service assigned to Oak Ridge National Laboratory, has received the Fuertes alumni medal of Cornell University, which is given annually by the faculty of the Civil Engineering School to a graduate of that school or to a recipient of a Cornell advanced degree. Dr. Straub was honored for an outstanding article on the treatment and disposal of radioactive wastes.

Arthur G. Thorp, II, formerly supervising engineer of advanced mechanical and instrument development at the aircraft gas turbine division of Westinghouse Electric Corp., Lester, Pa., has joined the staff of the Edison Research Laboratory as a senior mechanical engineer.

Milton V. Veldee, for 30 yr a medical officer with the U.S. Public Health Service, is now on the staff of Stanford Research Institute as chairman of the biology department. During most of his career Dr. Veldee has been engaged in medical research with special emphasis on infectious maladies and disease distribution. He has served on a number of committees of the World Health Organization, and before accepting his current appointment was vice president and medical director of Hyland Laboratories in Los Angeles.

Paul Weiss, who has been on the faculty of the University of Chicago for 21 yr and professor of zoology since 1942, has been appointed a member of the Rockefeller Institute for Medical Research. He will organize and direct a laboratory of developmental biology.

Walter T. Whitney, second chairman of the Pomona College astronomy department in the college's 66-yr history, retired in June on completion of his 25th year at the college. He succeeded the late Frank P. Brackett, founder of the department, in 1929. Dr. Whitney is also retiring from the faculty of Claremont Graduate School, on which he has served many years. Dr. Whitney received bachelor and master of science degrees at Pomona College and his doctorate in physics and astronomy at the University of Chicago. At Chicago he worked with the late Robert A. Millikan and went with him in 1917 to the California Institute of Technology, then known as Throop College. He joined Pomona from Caltech 12 yr later. He has been a member of the staff of Mt. Wilson Observatory on two oc-

casions. For the last 8 yr he has been intermittently engaged in research on the polarization of light from nebulae, work he started at MacDonald Observatory in west Texas and has continued at Pomona and at Mt. Wilson Observatory.

Dr. Whitney helped plan construction of the Seaver Laboratory at Pomona, which houses the Cassegrain reflector telescope given in memory of his aunt, Mrs. Clara Whitney Shatto. A Shatto memorial scholarship also provides $250 annually to an upperclassman or graduate student majoring in astronomy.

Harley A. Wilhelm, associate director of the Institute for Atomic Research and research professor of chemistry at the Iowa State College of Agriculture and Mechanical Arts, will receive the 1954 Iowa medal of the American Chemical Society's Iowa Section at a banquet on 12 Nov. He is a coinventor of the process adopted by the Manhattan Project during World War II for large-scale production of uranium metal and has also done work leading to more than 60 other inventions connected with the atomic energy program. His contributions have added to the knowledge of rare metals and their alloys, particularly the metallurgy of uranium, thorium, zirconium, and beryllium.

The American Museum of Natural History has announced the appointment of **John Todd Zimmer** as chairman of the department of ornithology. He has been with the museum since 1930, and succeeds **Robert Cushman Murphy,** who retains the post of Lamont curator of birds, but is resigning the chairmanship of the department to prepare for his retirement next year.

The appointment of **Harold A. Zintel** as attending surgeon and director of surgery at St. Luke's Hospital, New York, has been announced.

Meetings

On 28–29 June approximately 50 scientists met in Cambridge, Mass., to participate in a symposium on **aero-thermoacoustics.** The Massachusetts Institute of Technology acted as the host organization, and the opening address was delivered by C. Richard Soderberg, dean of the M.I.T. School of Engineering. The participants were recruited among aerodynamicists, acousticians, meteorologists, astrophysicists, and applied mathematicians.

Ten papers were presented on various phases of the connection of aerodynamics and thermodynamics to sound. In addition, four discussion panels were conducted to summarize and criticize our state of knowledge on various aspects of this growing field. The discussions that occurred during the meeting were of great help in clarifying several of the difficulties encountered and also in breaking down the technical language barrier between workers in different disciplines. The proceedings of the symposium will appear in the *Journal of the Acoustical Society of America.*

The **American Heart Association's Council for High Blood Pressure Research** will meet in Cleveland, 22–23 Oct. The scientific program will be on the metabolism of muscles and nerves as related to high blood pressure; the general program will feature a discussion on retirement problems. Irving S. Wright, of New York City, past president of the association, is chairman of the annual meeting.

Some 600 communications engineers attended an **Institute of Radio Engineers** technical session in Washington, 23–24 June. Featured speakers were Maj. Gen. Rex V. D. Corput, Jr., director of communications-electronics for the Defense Department's Joint Chiefs of Staff; Haraden Pratt, former telecommunications adviser to the President; and George W. Gilman, director of systems engineering for the Bell Telephone Laboratories.

New developments in **light and electron microscopy** will be discussed at coordinated conferences to be held at the Moraine hotel in Highland Park, Ill. The Armour Research Foundation of Illinois Institute of Technology will hold a symposium on light microscopy, 11–13 Oct., followed by a 3-day symposium on electron microscopy sponsored by the Electron Microscope Society of America.

The 35th summer meeting of the **Mathematical Association of America** will convene at the University of Wyoming 30–31 Aug. L. H. Loomis of Harvard University will moderate the three sessions of the meeting. Participants in the opening session, dealing with the educational aspects of computers, are W. F. Atchison, University of Illinois, "Education impact of the Illiac"; C. B. Tompkins, UCLA Numerical Analysis Project, "Effects of large digital computers on numerical analysis curricula"; and D. H. Lehmer, University of California, "A machine's-eye view of numerical analysis."

The second session, to be held jointly with the Canadian Mathematical Congress, will include P. Scherk, University of Saskatchewan, "Some geometric applications of Taylor's formula"; M. Wyman, University of Alberta, "Asymptotic expansions"; and B. M. Stewart, Michigan State College, "Systems of congruences."

The final session will deal with the preparation of college mathematics teachers, by P. V. Reichelderfer, Ohio State University; integral transformations and differential equations, by R. V. Churchill, University of Michigan; and metrics and matrices A. T. Lonseth, Oregon State College.

Infections and their management will be the subject of the 27th annual graduate fortnight of the **New York Academy of Medicine,** to be held 18–29 Oct. The program will include 21 evening lectures, 6 morning panel meetings, 10 hospital clinics, and a scientific exhibit. For programs and other information, address the Secretary, Graduate Fortnight, 2 E. 103 St., New York 29. Nonfellows of the Academy may register.

Southern women will contribute much toward implementing the recent Supreme Court decision against **racial segregation** in schools. This was the opinion of 25 leading American anthropologists and educators at a 4-day conference in Carmel Valley, Calif., held early in June. Presiding over a seminar, Solon T. Kimball of Columbia University, expressed the view that Southern leaders must be given the opportunity to define for themselves the way to meet the problem. The Stanford University School of Education, sponsor of the conference, made possible by a $10,400 Carnegie Foundation grant, will publish the results in conjunction with the American Anthropological Association.

"Our changing forests" is the theme of the 54th annual meeting of the **Society of American Foresters** to be held in Milwaukee, Wis., 24–27 Oct. E. L. Demmon of Asheville, N.C., president will open the general session. All foresters and friends of forestry, whether members of the Society or not, are welcome to attend.

Eleven technical sessions have been scheduled. Papers will be presented and discussed on the subjects of forest management, silviculture, forest products, private forestry, forest economics, watershed management, forest recreation, forest-wildlife management, range management, public relations, and professional education in forestry. For information, write the Society, 425 Mills Bldg., Washington 6, D.C.

Society Elections

Alpha Chi Sigma: pres., Walter T. Schrenk, University of Missouri; 1st v. pres., Ronald M. Warren, American Chemical Society; 2nd v. pres., L. Reed Brantley, Occidental College; 3rd v. pres., Frank Zvanut, firm of Godfrey L. Cabot, Cleveland; sec.-treas., John R. Kuehler, Indianapolis, Ind.

American Neurological Association: pres., Percival Bailey; pres.-elect, J. M. Nielsen; 1st v. pres., A. R. Vonderahe; 2nd v. pres., Paul C. Bucy; sec.-treas., H. Houston Merritt; asst. sec., Charles Rupp.

The **American Society of Mammalogists:** pres., William H. Burt; v. presidents, Robert T. Orr and William B. Davis; rec. sec., Randolph L. Peterson; treas., Caroline A. Heppenstall; corres. sec., George C. Rinker.

Chairman of the **Federation of American Societies for Experimental Biology** is D. Murray Angevine; secretary is M. O. Lee. The following, representatives of member organizations, will serve on the Federation board in 1954–55:

American Physiological Society: pres., H. E. Essex; pres.-elect, W. F. Hamilton; past pres., E. F. Adolph.

American Society of Biological Chemists: pres., C. G. King; sec., Philip Handler; past pres., D. W. Wilson.

American Society for Pharmacology and Experimental Therapeutics: pres., Charles M. Gruber, Sr.; sec., Carl C. Pfeiffer; past pres., Harvey B. Haag.

American Society for Experimental Pathology: pres., Russell L. Holman; sec., C. C. Erickson; past pres., D. Murray Angevine.

American Institute of Nutrition: pres., George R. Cowgill; sec., Rueben W. Engle; past pres., C. A. Elvehjem.

American Association of Immunologists: pres., A. M. Pappenheimer; sec., F. S. Cheever; past pres., Thomas P. Magill.

Education

Permanent headquarters for the **George Vanderbilt Foundation,** a newly formed scientific research organization, have been established in the Natural History Museum at Stanford University. The Foundation is now engaged primarily in fish studies, for which Stanford has been a center since the days of its first president, David Starr Jordan, an outstanding ichthyologist.

Gifts totaling $275,000 have been made to the Massachusetts Institute of Technology to establish a professorship in aeronautical engineering honoring **Jerome C. Hunsaker,** founder and for many years head of the department at M.I.T. The present endowment, received from many donors throughout the aircraft industry, is expected to be increased to $500,000 by further contributions. At the recent alumni luncheon James R. Killian, Jr., president of the Institute, commented: "This fund is a magnificant example of the kind of support which all private educational institutions must have to maintain their high standards of education supported by pioneering research studies."

Medical genetics, while still largely integrated with other courses, is now being taught in about 55 percent of the medical schools in the United States and Canada, writes C. Nash Herndon of Bowman Gray School of Medicine, Wake Forest College, in the July issue of *The Journal of Medical Education.* Dr. Herndon states that at Bowman Gray "we try to make our students aware of genetic factors in disease." The subject, taught in two sections under the department of preventive medicine, consists of a course in basic principles combined with pathology, physiology, and microbiology and a course called "hereditary disease."

Forty-two U.S. engineering schools and six in Canada will this year distribute a total of $19,200 in scholarships sponsored by the American Society for Metals Foundation for Education and Research to support students pursuing **metallurgical studies.**

Michigan State College will celebrate its 100th anniversary next year. Delegates from more than 500 universities and learned societies will be invited to the formal opening of the centennial on 12 Feb. 1955, which is Founders' Day at the college. An industrial

exposition will be held 11–14 May and the Centennial of Farm Mechanization will take place 16–20 Aug. Academic symposia will feature such topics as "Administering human affairs, 1955–2000"; "Nutrition of plants, animals, and man"; and the "New view of man—a synthesis and forecast."

Sterling Morton, chairman of Morton Salt Co., recently laid the cornerstone of the new **Morton Medical Research Building** at the Northwestern University Medical Center. The seven-story structure will be occupied by research personnel who have carried on their work in laboratories of the Montgomery Ward Memorial Building. The new laboratory is scheduled for completion in May 1955, and is the first medical building erected by Northwestern since the Ward building was finished in 1926. Construction is being financed by a $2 million bequest left to the University by Margaret Gray Morton, widow of the founder of the Morton Salt Co.

Grants and Fellowships

The following grants and fellowships administered by the **National Academy of Sciences–National Research Council,** have recently been announced.

American Cancer Society Fellowships in Cancer Research

P. Berg, dept. of microbiology, Washington University.

F. Dituri, dept. of medicine, University of Pennsylvania.

E. Farber, dept. of pathology, Tulane University School of Medicine.

H. R. Garner, dept of biological sciences, Purdue University.

C. Gilvarg, dept. of biochemistry, Bellevue Medical Center.

R. D. Griesemer, dept. of dermatology, Massachusetts General Hospital.

J. M. Price, dept. of clinical pathology, University of Wisconsin.

J. F. Scott, dept. of medicine, Massachusetts General Hospital.

P. Talalay, Ben May Laboratory for Cancer Research, University of Chicago.

J. M. Weiss, dept. of anatomy, Washington University.

American Cancer Society Fellowships in Cancer Research

P. Aisen, Columbia University, with I. M. London. 1. Origins of bile pigment from sources other than the hemoglobin of mature circulating erythrocytes; 2. Metabolic behavior of various constituents of the erythrocyte.

A. C. Aisenberg, University of Wisconsin, with V. R. Potter. 1. Conversion of acetate and glucose to CO_2 and investigation of the Pasteur effect; 2. Conversion of glucose to nucleoprotein ribose.

J. B. Alpers, Sloan-Kettering Institute, with R. W. Rawson. Hydrolysis of thyroglobulin by intrinsic enzyme systems.

E. P. Anderson, National Institutes of Health, with H. L. Kalckar and B. L. Horecker. Role of the purine and pyrimidine nucleotides in nucleic acid synthesis and transglycosidation.

R. S. Benua, Western Reserve University, with B. M. Dobyns. Functional nature of thyroid tissues with special emphasis on radioiodine radiated thyroids and thyroid tumors.

D. P. Bloch, Columbia University, with A. W. Pollister. Synthesis of desoxyribonucleic acid and histone during the course of the mitotic cycle.

L. N. Caston, Jr. University of Cambridge, with D. Keilin. Photochemical action spectrum of CO inhibited respiration.

H. M. Davidson, Tufts College Medical School, with G. Schmidt and W. H. Fishman. 1. Metabolism of phosphoprotein; 2. Characterization of purified prostatic acid phosphatase.

G. W. deVillafranca, Institute for Muscle Research, Woods Hole, with A. Szent-Györgyi. Some biochemical and biophysical properties of the myosin proteins about the time of first contraction in embryonic mammalian muscle.

R. J. Doisy, University of Wisconsin, with H. A. Lardy. Protective actions of cholesterol or pantothenic acid on induced hyperthyroidism in rats.

R. M. Franklin, California Institute of Technology, with R. Dulbecco. Quantitative studies on the Rous sarcoma virus.

N. Freinkel, Thorndike Memorial Laboratory, Boston, with W. B. Castle. Transport of inorganic iodide.

J. A. Gladner, Massachusetts Institute of Technology, with J. M. Buchanan. Cofactors involved in purine and nucleotide biosynthesis.

D. P. Groth, Université Libre de Bruxelles, with J. Brachet. Use of biochemical methods in the study of growth, differentiation, and cellular physiology.

I. M. Harary, National Institutes of Health, with E. Stadtman. Acyl thiol ester transfer enzymes.

R. B. Hurlbert, University of Copenhagen, with H. Kalckar and H. Klenow. Enzymatic mechanisms and intermediates in the biosynthesis of nucleic acids.

J. Hurwitz, National Institutes of Health, with B. L. Horecker. Glucose-6-phosphate oxidative cycle.

M. E. Jones, Massachusetts General Hospital and Harvard Medical School, with F. Lipmann. Mechanism of various synthetic reactions involving energy-rich enzyme-substrate complexes.

B. H. Judd, University of Texas, with W. S. Stone. Role of heterochromatic rearrangements as modifiers of the variegated-type position effect in *Drosophila melanogaster*.

D. Kahn, Norwegian Cancer Institute, Oslo, with J. Baarli. Effect of heavy ion elastic scattering and inner shell ionization on complex organic molecules.

R. H. Kahn, University of California, with K. B. DeOme. *In vitro* action of hormones on secondary sex accessories.

A. D. Kaiser, Pasteur Institute, Paris, with A. Lwoff and F. Jacob. Genetic analysis of the temperature bacteriophage "Lambda."

J. C. Kaltenbach, Wenner-Grens Institut, Stockholm, with J. Runnström. Antigens during embryonic development.

R. Kimmelstiel, Harvard Medical School and Boston Lying-In Hospital, with A. B. Hastings and C. A. Villee. Utilization of carbon-14 labeled amino acid by the human placenta *in vitro*.

A. J. Ladman, Harvard Medical School, with G. B. Wislocki. Histochemical studies of the anterior pituitary and the adrenal medulla of rodents under normal and experimental conditions.

K. G. Lark, State Serum Institute, Copenhagen, with O. Maaløe. Cytological, physiological and biochemical properties of *Salmonella typhimurium* in relation to the mitotic cycle of this organism.

I. Lewin, Royal Cancer Hospital, London, with A. Haddow. Effect of steroid hormones on xanthine oxidase in normal and neoplastic tissue.

S. A. Luse, Washington University School of Medicine, with E. W. Dempsey. Investigation of the histologic anatomy of the nervous system by means of electron microscopy and histochemistry.

W. S. Lynn, University of Pennsylvania, with S. Gurin. Cholesterol catabolism.

J. Marmur, Pasteur Institute, Paris, with A. Lwoff and J. Monod. Genetic studies associated with bacterial transformations.

M. P. F. Marsden, Harvard University, with R. A. Wetmore. Use of *in virto* culture techniques as a tool in studying normal and abnormal growth in vascular plants.

H. T. Meryman, Yale University, with E. C. Pollard. Genetic components of hydrated microorganisms in the solid state by particulate and electromagnetic radiations.

J. F. Migliarese, University of Kansas, with R. E. Stowell and C. G. Bly. Chemicarcinogensis: tumor-host relations.

M. W. Noall, Tufts College Medical School, with H. N. Christensen. Mode of production of endocrine influences upon nitrogen metabolism.

C. R. Partanen, Columbia University, with A. W. Pollister. Comparative quantitative determinations of nucleic acids in organized and unorganized plant growth *in vitro*.

D. M. Prescott, Carlsberg Laboratories, Copenhagen, with H. Holter. Role of the nucleus in interphase activities of the cytoplasm of amoeba proteus.

H. V. Rickenberg, Pasteur Institute, Paris, with J. Monod. Nature of the induction process in the formation of induced enzymes and interactions between enzyme-forming systems.

R. M. Rosenbaum, Beth Israel Hospital, Boston, with J. Fine. *In vivo* study of the phagocytic blood elements in the normal state and in shock.

H. Rubin, California Institute of Technology, with R. Dulbecco. Life cycle of the Rous sarcoma virus.

K. J. Ryan, Massachusetts General Hospital, with F. Lipmann. Mechanisms in enzymatic reactions.

S. A. Sand. Brookhaven National Laboratory, with A. H. Sparrow. Somatic mutation and chronic irradiation.

R. B. Schultz. Harvard Medical School and The Children's Hospital, Boston, with J. F. Enders. Tumor-virus relationships.

S. K. Shapiro. Yale University, with D. M. Bonner. Genetic control of enzyme formation.

J. E. Smith. Purdue University, with H. Koffler. Molecular architecture of the cell walls of *Penicillium chrysogenum* Q176.

J. Straus. Harvard University, with K. V. Thimann. Factors affecting the rooting response of excised cotyledons of red and black radish.

A. R. Terepka. University of Rochester, with E. H. Keutmann and C. Waterhouse. Clinical and metabolic observations during forced-feeding of cancerous patients.

R. S. Thomas. Carlsberg Laboratories, Copenhagen, with H. Holter. Function and intracellular localization of macromolecules of rat liver cell homogenates.

K. Tryon. University of Wisconsin, with F. Skoog. Comparative physiological studies of differentiating and nondifferentiating tobacco tissue *in vitro*.

J. E. Whitney. University of Cambridge, with F. G. Young. Influence of pituitary hormones on growth and metabolism.

British American Exchange Fellowships in Cancer Research

S. Gelfant. University of London, with W. S. Bullough. *In vitro* studies of the growth effects of gonadal hormones on sexual and nonsexual tissues.

G. D. Shockman. Oxford University, with D. D. Woods. Some aspects of amino acid and protein synthesis by living microorganisms.

E. L. Smith, University of Cambridge, with D. Keilin. Reactions of the cytochrome system.

National Tuberculosis Foundation
Fellowships in Tuberculosis

R. H. Shepard. Johns Hopkins University, with J. L. Lilienthal, Jr., and R. L. Riley. Estimation of oxygen tension in whole blood: Application to assessment of pulmonary function.

G. M. Turino. Columbia University and Presbyterian Hospital, with D. W. Richards. Evaluation and separation of resistive forces to lung ventilation in states of normal and abnormal pulmonary function.

James Picker Foundation
Fellowships in Radiological Research

M. G. Smyth, Jr. University of Pennsylvania, with R. H. Chamberlain. Distribution and dosage of colloidal and particulate sources of radioactivity.

K. Subbarao. Bellevue Hospital, with M. H. Poppel. Regional ileus as a roentgenological manifestation of disease.

Miscellaneous

In April 1953 a supplement to Vol. 13 of *Cancer Research* was published in order to present a backlog of negative data on compounds tested in experimental cancer chemotherapy programs. A second supplement, made possible by a grant from the National Cancer Institute of the U.S. Public Health Service, is planned for publication early in 1955. This will present additional negative data, and also data from clinical cancer chemotherapy programs. Material for inclusion in the supplement is invited; it must be received by one of the editors *before 15 Oct.* For information regarding preparation of data for submission, communicate with C. Chester Stock, Sloan-Kettering Institute for Cancer Research, 410 E. 68 St., New York 21.

Prevention of Deterioration Center—A Service for the Department of Defense is the title of the new brochure recently issued by the Prevention of Deterioration Center, Division of Chemistry and Chemical Technology, National Research Council. Designed to supplant the so-called "Red Book" of June 1949, this 20-page booklet outlines the deterioration problem in its broad aspects, traces the history, origin, and organization of the Prevention of Deterioration Center, and describes present services and professional activities of this Academy–Research Council group. Interested persons may obtain a copy gratis from the Prevention of Deterioration Center, 2101 Constitution Ave., Washington 25, D.C.

The August issue of ***The Scientific Monthly*** features the following articles: "Army Medical Museum and Armed Forces Institute of Pathology in historical perspective," Morris C. Leikind; "Armed Forces Institute of Pathology: retrospect and prospect," Hugh G. Grady; "New building facilities for Armed Forces Institute of Pathology," Colin F. Vorder Bruegge; "Views on the Amazon Valley," F. A. Carlson; "Dust explosion in coal mines and industry," Irving Hartmann; "Importance of rhythm in songs for the treatment of the sick by American Indians," Frances Densmore; "The pseudomath," Tobias Dantzig; "Computers: 1954," Mina Rees; "The economics of power reactor processing," D. E. Ferguson; "Spotting forest fires with television," Ed. Kerr.

The Women's Bureau of the U.S. Department of Labor has prepared a new bulletin on the Opportunities for Women series, entitled ***Professional Engineering.*** It gives an over-all view of engineering as a career for women, and is an excellent reference source for those interested in obtaining authoritative information on the subject.

Developments in the physical sciences which have taken place in the past two decades are reflected in the 9th revised edition of the **Smithsonian Physical Tables.** For more than a century this has been a standard reference book in American laboratories; it is revised about once every 20 yr. Entirely new sections have been added, including one on nuclear science. The new edition, prepared for the Smithsonian Institution by William E. Forsythe, retired General Electric Co. physicist, includes 901 tables.

Tropical Woods is again being published on a regular basis. It will appear semiannually, but it is hoped that in the near future enough articles will be forthcoming to justify increasing the number of issues. Published by the Yale University School of Forestry, *Tropical Woods* was founded in 1925 by Samuel J. Record, who served as its editor until his death in 1945. The journal is designed to furnish a suitable publication medium for writings on wood anatomy, tropical woods, woody plants and the promotion of forestry in the tropics.

The subscription rate will be $1.50 annually or $1.00 for a single issue. Subscriptions should be sent to the Assistant to the Editor, *Tropical Woods*, 205 Prospect St., New Haven, Conn. Information concerning submission of manuscripts is available from the editor, William L. Stern, at the same address.

Book Reviews

The Geography of the Flowering Plants. Ronald Good. Longmans, Green, London–New York, ed. 2, 1953. 452 pp. Illus. + plates. $10.

The great need for a first-class textbook on plant geography makes the appearance of a revised edition of Good's 1947 book a matter of great interest. It is satisfying to note that many of the obvious shortcomings of the first edition have been eliminated and that this volume goes a considerable way toward filling the need for a modern treatment of one of the most fascinating branches of botany.

As is usual with discussions of plant geography, the four main branches of the subject have not been given equal treatment. Floristic and historical plant geography are treated exhaustively, but physiological plant geography (vegetation science) and economic plant geography are scarcely treated at all.

The plan of this book is generally quite logical. After an introduction, there are three introductory chapters, providing an outline of the geography of the world, a division of it into floristic regions, and some general aspects of plant geography. Then follow eight chapters of detailed statistical information on the distribution of families, genera, and species; then two chapters on the history and distribution of British plants, and one on the geologic history and past distribution of the flowering plants. These make up part I. Part II consists of six chapters on the factors of distribution, with one on Good's theory of tolerance, and a chapter of conclusions. In addition, there are appendixes providing statistics on the world's land surfaces and a list of discontinuous genera. There are also an extensive bibliography and three indexes to the contents—one of subjects, one of plant names, and one of persons and places. The book is illustrated by 25 plates and 75 text illustrations. The revision of the first edition has obviously been very thorough, bringing in data from many papers as late as 1950 and even some published in 1952.

The comprehensive nature of this book, and the great interest of the subject matter warrant a much more detailed and critical consideration of some of these sections than space allows. It is, however, of interest to note that the elementary nature of the introduction suggests that the book is directed toward a popular audience with no particular botanical background. There is little doubt, though, that such readers would be well over their depth before they had read far into the main text. Sixteen of the plates are excellent reproductions of beautiful photographs of vegetation which, since they have no relation to the text, must be regarded as ornamentation to attract the same popular audience.

The enormous mass of statistical information on the distribution of plants, important as it is, serves well to emphasize the diffuse and unsatisfactory nature of the subject matter of plant geography. This is, of course, but a reflection of the fact that the taxonomy of plants is not in a very advanced state and that consideration of any other major aspect of botany is consequently limited.

The section on the British flora, one chapter on its history and distribution, another on the local distribution of plants in an English county, are among the truly excellent parts of the book. The "theory of tolerance," treated in Chapter 21, is apparently considered by the author to be his major contribution to plant geography. It seems eminently sound if somewhat obvious. The summarization, in the concluding chapter, of the history of the flowering plants into a long favorable period of only slow change with widespread generalized types, followed by a period of sharp differentiation of habitats in the late Tertiary and then by the Pleistocene disaster is interesting and well supported by the material presented.

One may sum up one's general impressions by saying that, although this is certainly not a book to be recommended to the casually interested reader or even the usual amateur naturalist, there is an enormous fund of information here for the critical student of plant geography and related fields. It is still not, however, the elementary textbook which is so much needed for beginning plant geography courses, nor will it likely be very satisfactory for even advanced general geography students to round out their background in the botanical phases of their science.

F. R. Fosberg

Falls Church, Virginia

Light. R. W. Ditchburn. Interscience, New York, 1953. 701 pp. Illus. + plates. $7.

This textbook on physical optics was written for students who have finished the study of physics and mathematics on the intermediate level. The author's aim is to give such students a thorough acquaintance with the manifold phenomena of light radiation, to show them the accomplishments and limitations of the different theories, and finally to present to them the ideas and formulations of the modern quantum mechanics, as developed by Dirac, which resolves the main difficulties of the particle-wave conflict.

There exists no other textbook on this level that contains so many details about the experimental background or goes so far into the theoretical treatment. Only a man of such comprehensive knowledge of the subject and of such superior pedagogical gift as the author possesses could successfully undertake this difficult, although alluring, task.

About half of the book deals with the general aspects of wave theory and the treatment of phenomena and instruments. Three chapters on "Velocity of light," "Relativistic optics," and "Polarized light" conclude this general part. Theoretical and experimental considerations are well balanced, and certain topics are treated in much greater detail than in other

textbooks of the same level. Examples are Chapter IX on measurements with interferometers and Chapter IV on wave trains of finite length. Appropriate figures and five plates accompany and elucidate the text.

The next four chapters treat the classical electromagnetic theory, including the theory of absorption, dispersion, and anisotropic media. A chapter on "Interaction of radiation and matter" makes the student familiar with quantum effects and leads naturally to the last chapter on "Quantum theory of radiation." The space allotted to the treatment of these two chapters is definitely too limited, and therefore the presentation contrasts unfavorably with that of the earlier chapters. However, it must be admitted that this shortcoming is partly due to the topic itself. The student must have made considerable progress in mathematics during the advance of this course in order to be able to grasp the content of this last part. But even when the student is not able to absorb all the details presented, he will definitely profit from reading the sections of more general content, which give a clear picture of the trend of the modern theory.

It can hardly be avoided that such a comprehensive treatment as this is not free from occasional defects. One misses the names of Franck and Hertz in section 17.11 on critical potentials. One of the weakest parts is section 17.5, which deals with the regularities in line spectra of atoms. This brief section needs considerable extension and clarification. Ritz's combination principle is of such fundamental importance that its mention in one obscure sentence is not sufficient. Furthermore, it may be mentioned that Fig. 19.2 does not represent the rosette orbit of a simple harmonic oscillator in a magnetic field (as claimed in the text) but that of a precessing Kepler-ellipse. It should be replaced by another one. However, these minor defects cannot affect the otherwise excellent impression of the book, which in general is characterized by clarity, detailed treatment, and a high degree of completeness.

K. W. MEISSNER

Physics Department, Purdue University

Nature and Structure of Collagen. Papers presented for a discussion convened by the Colloid and Biophysics Committee of the Faraday Society at King's College, London, 26–27 Mar. 1953. J. T. Randall, Ed. Academic Press, New York; Butterworths, London, 1953. 269 pp. Illus. $6.50.

The problem of the structure of collagen is as yet unsolved. At the suggestion of J. T. Randall, an informal discussion of the properties of collagen in relation to its structure was held recently. Many of the principal workers in the field contributed papers, dealing with the histology and nature of connective tissue, the metabolism of collagen, the properties of collagen solution, the chromatography of amino acids in collagen, the precursors of skin collagen, the x-ray diffraction pattern of collagen fibers, the structure of collagenous tissue and collagen preparations as shown by electron micrographs, and a number of other subjects. The book containing these papers and the discussion that was given them by participants in the meeting can be recommended to everyone interested in collagen and connective tissue.

LINUS PAULING

Gates and Crellin Laboratories
California Institute of Technology

The Physical Chemistry of the Silicates. Wilhelm Eitel. Univ. of Chicago Press, Chicago, 1954. xvii + 1592 pp. Illus. $30.

The author, director of the Institute of Silicate Research, University of Toledo, presents a most complete encyclopedia of the silicates. This book is an extended, up-to-date English version of the well-known German standard work on silicates, which Eitel wrote while he still was director of the Kaiser Wilhelm Institut für Silikatforschung in Berlin. The work is far more comprehensive than the title indicates. On account of the excellent general review of reactions in the solid state and the detailed description of the mechanism and kinetics of sintering, it not only is of interest to ceramists and silicate chemists but is also fascinating for metallurgists and solid state physicists.

The book consists of five parts. Part I, which is the most comprehensive, with more than 500 pages, describes the crystalline state in general, the special structures in silicates, such as isolated, chain, layer, and framework structures. It further contains a complete analysis of the fused and glassy states, the constitution and physicochemical properties of melts and glasses. The colloids also are described in this part, and attention is especially called to the systematic discussion of the clay-water system as colloidal phenomena in silicate systems and to the intimate relationship of changes in fired clays with reactions in the solid state.

Part II is concerned with the fusion and polymorphic equilibria in dry silicate systems. A description of the various methods for the determination of fusion points introduces this part, which contains interesting details on the correlation between undercooling and crystallization and on polymorphic inversions. A brief discussion on the effects of pressure on inversion equilibria, with references to the work by Bridgman, Tammann, and Sosman, is of great actuality with respect to some recently described effects of pressure in metallurgical diffusion work. More than 200 pages, containing 150 phase diagrams, are devoted to special silicate systems such as alkali-, aluminum-, heavy metal-, and the presently much-discussed borosilicate systems.

Part III covers the silicate systems with volatile components and silicate hydrates. The gas absorption phenomena in fused silicates are described in detail. Many readers will be especially interested in the discussion of hydrothermal mineral synthesis. This remarkable synthesis of clay minerals, and others, by hydrothermal reactions of different minerals of the

feldspar group under high simultaneous pressures of water and carbon dioxide at elevated temperatures, is described extensively under consideration of the latest developments in this field. A detailed analysis of the silicate hydrates of the Zeolite and Permutit group also covers the dehydration of silicate hydrates and the various types of water binding.

Part IV, entitled "Solid state reactions and their ceramic use," considers the mechanism of sintering and correlation between structural defects and their reactions in the solid state, with special emphasis on the work by Hedvall. The material migration on the contact between reacting solids and systematic investigations on reactions in the solid state for silicate synthesis are some of the high lights of this general review of the present status of solid state research and development. This part further contains a description and discussion of the reactions in ceramic bodies and in hydraulic cements, with accent on the hydration of cements, including valuable comments on the colloidal theories of cement hardening.

The last part of this standard work is concerned with the silicate melts and industrial glasses and slags and describes the reactions in glass melting and the highly complex constitution of slags.

This monumental encyclopedia is characterized by an especially careful system of indexing. A 72-page subject index is followed by an index to minerals and rock species, a systematic index of the special silicate melt equilibria, an index of chemical compounds, and a 44-page author index for references. Each paragraph of the book is numbered, which permits quick reference and cross-reference. Clearly and systematically written and well printed, this will be used as a standard work for many years.

HENRY H. HAUSNER
Department of Metallurgy, Polytechnic Institute of Brooklyn
Atomic Energy Division, Sylvania Electric Products, Inc., Bayside, New Jersey

Fundamentals of Ecology. Eugene P. Odum. Saunders, Philadelphia, 1953. xii + 384 pp. Illus. $6.50.

This is the first introductory textbook in ecology since the publication of "that noteworthy milestone" by Allee *et al.* in 1949. Where the trees were obscured by the forest, so to speak, here they are neatly arranged and the forest appears as an orderly grove; in short, Odum has done an excellent job in conciseness, and his title is fully justified. This is also the first effort to summarize the ecosystem or trophodynamic approach (characteristic of the Yale or Hutchinson school) to ecology, but adequate consideration is also given to the traditional habitat approach. Since the author is a terrestrial ecologist, it is natural that most of his examples and illustrations should be drawn from terrestrial studies and that marine ecology should be slighted somewhat (at least from the viewpoint of a marine ecologist). Almost six pages in the chapter on marine ecology are devoted to a series of figures from a standard textbook; these pages might better have been used for fuller discussion of some points. The section on commensalism is too short to be of real value. On the whole, however, the book presents a well-balanced view of the broad field of ecology, drawn from practical teaching experience.

The writing is clear, concise, and for the most part free from specialized terminology. The author's recommendation that *littoral* be abandoned as a term in marine ecology will not be well received, and his use of *biogenic* for "dissolved salts vital to life" will startle marine ecologists, who have used "nutrient salts" in this meaning and adhere to the long-established meaning of *biogenic* in its geologic sense as applying to inorganic materials or structures formed by biological agency. There are few such slips, however, aside from the author's apparent inability to spell people's names correctly, and these can be corrected in a new edition. The illustrations are clear and well chosen, and there is a good bibliography and index.

JOEL W. HEDGPETH
Scripps Institution of Oceanography, La Jolla, California

Nuclear Moments. Norman F. Ramsey. Reprinted in part from ***Experimental Nuclear Physics,*** vol. I, E. Segrè, Ed. Wiley, New York; Chapman & Hall, London, 1953. 169 pp. Illus. $5.

Since World War II, a large number of papers have appeared in the literature on research in radio- and microwave-frequency resonance phenomena. *Nuclear Moments* by Norman F. Ramsey performs a service, which has long been in demand, of describing the basic achievements of various resonance experiments dealing with the magnetic dipole and electric quadrupole moments of stable nuclei. Along with liberal references, complete tables of nuclear moments and related properties, an appendix on nuclear shell structure, and a review of the theory of nuclear moments as applicable to any experiment, the author devotes the main discussion to a correlation of various experimental results obtained by different workers. In short order the reader is given an excellent survey and a pertinent description of topics of current interest that will serve as a useful guide in seeking further details in the scattered literature.

The book is written in five parts. Particular emphasis is placed on resonance studies of chemical structure and the solid state, in the interest of many who are currently engaged in such work. Two introductory chapters present the fundamental definitions and properties of nuclear moments. A precise formulation is given of the types of interactions between the nucleus and surrounding atomic and molecular fields. The next chapter opens the topic on experimental methods by a review of molecular-beam nonresonance experiments, followed by a discussion of present-day molecular beam and neutron beam resonance techniques. The next part outlines the techniques and

theory of nuclear paramagnetic resonance and microwave spectroscopy. Next, a chapter presents the results of nuclear moment measurements with tables and complete references on measured values of nuclear moments, nuclear moment ratios, magnetic-shielding corrections, and hyperfine structure separations. The last part of the book covers a wide variety of topics on recent developments in chemical and solid state applications of resonance techniques.

Nuclear Moments is useful to those who desire an introduction to experiments and theory of current interest in radio-frequency resonance and also to those who are specialists in this field.

E. L. HAHN

Watson Scientific Computing Laboratory
Columbia University

The Philosophy of Science. Stephen Toulmin. Hutchinson's Univ. Library, London, 1953. (U.S. distr.: Ulric Nisbet, 62 E. 83 St., New York 28.) 176 pp. $2.25.

With so many books available on the subject, one may well consider the justification of introducing this additional work. Nevertheless, in discussing the philosophy of science, Toulmin writes succinctly, enabling the layman to comprehend better the role of science in today's world and assisting the scientist to grasp the significance of his endeavors.

The book is aimed toward the layman in that the author has assumed "no special knowledge either of mathematics or of natural science." It differs from many popular treatises, however, in that a rigorous philosophical presentation is advanced. In fact, it is this rigor that distinguishes Toulmin's work from that of many contemporary authors. With the help of frequent examples, the transition from common sense to science is unfolded. The relative roles of theories, hypotheses, principles, laws, and mathematics are all distinguished. For instance, in clarifying the role of physical law, we have

> . . . there is no need for us to be puzzled by the question whether Newton's laws are descriptions, definitions, or assertions about methods of measurement: rather, it is up to us to see how in some applications physicists may use them.

Again,

> . . . physics is not in the formulae . . . as we are often inclined to suppose. . . . The problem of *applying* the theoretical calculus remains in physics the central problem, for a science is nothing if its laws are never used to explain or predict anything.

Since the evolution of physics to quantum mechanics and relativity, much has been written in an attempt to assimilate philosophy and these modern concepts. Consequently, much of what is written now concerning the philosophy of science delves deeply into phases of physics not understood by the layman, most philosophers, and indeed not all physicists. Toulmin considers the philosophy of such basic scientific concepts as uniformity of nature, determinism, and induction. That he does so without sacrifice of rigor makes this introduction to the philosophy of science a compelling attraction for the scientist, the philosopher, and the student.

DONALD J. LOVELL

Pasadena, Maryland

A Glossary of Terms in Nuclear Science and Technology. National Research Council Conference on Nuclear Glossary. American Society of Mechanical Engineers, New York, 1953. 9 sections. $7.

The National Research Council established a Conference on Glossary of Terms in Nuclear Science and Technology in 1948 to prepare definitions of terms peculiar to the field of nuclear energy or used in that field differently or more frequently than in other fields. Separate sections were initially prepared on the following subjects by the individuals indicated: *Physics* (Henry Semat); *Reactor Theory* (Nicholas M. Smith, Jr.); *Reactor Engineering* (Clinton J. T. Young); *Chemistry* (T. O. Jones and Hoylande D. Young); *Chemical Engineering* (Arthur P. Weber); *Biophysics and Radiobiology* (Edith H. Quimby); *Instrumentation* (G. Wesley Dunlap); *Isotopes Separation* (Karl Cohen); and *Metallurgy* (Morris Kolodney). After review by a number of persons and by special committees, the sections were issued as preliminary editions from 1950 to 1953. They range in length from 7 pages for *Isotopes Separation* to 62 pages for *Physics* and can be purchased separately at prices ranging from 60¢ to $2.50 or bound together with an index for $7.

The index lists almost 2000 terms for the glossary as a whole. There are variations in the approach and amount of detail among the different sections, the one on *Physics* being the most thorough. The sections on *Chemical Engineering* and *Metallurgy* consist largely of terms in common usage in nonnuclear as well as nuclear fields. The section on *Physics* includes a number of equations and the section on *Reactor Theory* a number of mathematical terms, some of which are difficult to explain in a brief space. Numerous terms are included in two or more sections, often with different wordings of the definition. About 50 typographical errors were found in the entire glossary, the largest number being in the *Physics* section. Many of these errors are obvious but some are confusing.

This glossary is a useful one and fills a particular need, since the rapid growth of the field of nuclear energy has introduced many new or specialized terms into scientific and technical language. Their systematic collection and definition is a valuable undertaking that should assist in the clarification and standardization of usage. Now that all the sections have been issued, they need to be coordinated and consolidated into a unified glossary. The prefaces of the various sections indicate that this is under consideration.

PAUL C. FINE

U.S. Atomic Energy Commission, Washington, D.C.

New Books

The Kachina and the White Man. A study of the influences of white culture on the Hopi Kachina cult. Frederick J. Dockstader. Cranbrook Institute of Science, Bloomfield Hills, Mich., 1954. xiv + 185 pp. Illus. + plates. $5.

Basic Botany. An introduction to the science of botany. Fred W. Emerson. Blakiston, New York, ed. 2, 1954. xiii + 425 pp. Illus. $5.

The Development of Medical Bibliography. Estelle Brodman. Medical Library Assoc., Baltimore, 1954 (Order from Archives Curator, Medical & Chirurgical Faculty of State of Maryland, Baltimore 1). ix + 226 pp. Illus. + plates. $5.

Nature and Nurture: A Modern Synthesis. John L. Fuller. Doubleday, Garden City, N. Y., 1954. vi + 40 pp. Paper, $0.85.

The Alkaloids: Chemistry and Physiology, vol. IV. R. H. F. Manske and H. L. Holmes, Eds. Academic Press, New York, 1954. x + 357 pp. $8.50.

The Structures and Reactions of the Aromatic Compounds. G. M. Badger. Cambridge Univ. Press, New York, 1954. xii + 456 pp. Illus. $11.50.

The First Australians. Ronald M. Berndt and Catherine H. Berndt. Philosophical Library, New York, 1954. 144 pp. Illus. + plates. $4.75.

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Introduction to Mathematical Statistics. Paul G. Hoel. Wiley, New York and Chapman & Hall, London, ed. 2, 1954. xi + 331 pp. Illus. $5.

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Technical Papers

Intensity of White Noise and Frequency of Convulsive Reactions in DBA/1 Mice

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The bell-tub method devised by Hall (*1*) for inducing audiogenic seizures in mice involves stimulating mice placed in an ordinary washtub for a period of 90 to 120 sec with noise produced by the ringing of an electric doorbell over the tub. Although this method has been widely used in studies of audiogenic seizures during the past 6 yr, relationships that may exist between variable aspects of the stimulus used in the method and incidence of seizures have not yet been systematically studied. That the intensity of the stimulus is an important factor governing occurrence of audiogenic seizures in mice has already been shown by Frings and Frings (*2*) who found a probable sigmoid relationship between intensity of a pure 10-kc/sec tone and incidence of seizures in mongrel albino mice. The present study (*3*) was designed to obtain further information concerning the relationship between stimulus intensity and seizure incidence in the more genetically homogeneous DBA strain of mice in a situation employing a stimulus similar in complexity to that used in the bell-tub method.

Control over the stimulus and a wide intensity range were obtained by using an H. H. Scott Noise Generator, Type 810-A. The output of the noise generator, which consisted of white noise over the range of 2 to 15 kc/sec according to information supplied by the manufacturer, was amplified with a Lafayette Model 2N189 amplifier. Amplifier controls were set for maximum attenuation of low frequencies to protect the reproducer, a University, Model M1DT, high-frequency loudspeaker. The loudspeaker was suspended with rubber bands directly over a 4-in. square, 6-in. high, clear plastic test cage. Eleven equally spaced $\frac{1}{8}$ in. round brass rods formed the top of the cage. This small open-bottom cage was placed on a clean sheet of paper within a larger, partially soundproofed compartment, which was 14 in. deep, 16 in. wide, and 22 in. high, and had a clear glass front. A door, 16 in. wide and 6 in. high, below the glass front permitted access to the interior of the larger compartment.

A total of 80 mice, 40 males and 40 females, of the DBA/1 strain were used as subjects. Mice 30 to 34 days old were chosen, since Vicari (*4*) has shown that mice of the related DBA/2 strain are maximally susceptible to seizures at this age. The mice were randomly assorted into four experimental groups, each composed of 10 males and 10 females as a control for the slight sex difference in seizure susceptibility that has been noted in this strain.

The procedure was similar to that described by Vicari (*4*). Each mouse was carried by the tail from an outside room to the room containing the apparatus. The mouse was then placed under the small test cage inside the larger compartment. After a 10-sec adaptation period, a switch was thrown to connect the loudspeaker to the amplifier. Stimulation was continued for 90 sec or until death of the subject. Each mouse was tested only once.

Four levels of white noise intensity at the floor of the small test cage were used, respectively, with the four experimental groups: 110, 115, 120, and 130 db above 0.0002 dynes/cm^2 rms pressure. In setting sound pressures at these levels, an H. H. Scott Sound Level Meter, Type 410A, was used with the microphone placed on the floor within the test cage. Momentary variations of ± 1 db from each of the four levels occurred frequently. The range of variation of sound pressures from the center to peripheral points of the test-cage floor could not be measured accurately, owing to the large diameter of the microphone. Maximal peripheral displacement of the microphone produced no noticeable change in sound-pressure readings. At the top of the test cage, sound-pressure readings were 3 to 4 db above floor-level readings, momentary variations remaining ± 1 db.

Since a small test cage was used to minimize variations in stimulus intensity, the typical preseizural wild running of the subject that is elicited with the bell-tub method could not occur. Instead, preseizural behavior took the form of wild jumping. The criterion assumed in recording wild jumping was two or more jumps in rapid succession. Latencies of the convulsive reactions that occurred were measured with a stop watch from the onset of sound to the instant when the mouse fell over on its side. The results are summarized in Table 1.

In every instance when fatal or nonfatal convulsions occurred, wild jumping preceded the convulsions by a few seconds. The mean latencies of the convulsive reactions that did occur were 37.0, 38.0 and 34.2 sec, respectively, for mice in the 115-, 120-, and 130-db groups. Latencies ranged between 9.6 and 51.9 sec, both of these extremes occurring in the 130-db group. Since mean latencies are based on such small numbers, they are not regarded as reliable enough to indicate any trend.

When the percentages of fatal and nonfatal convulsions shown in Table 1 are totaled and plotted

Table 1. Percentage incidence of fatal and nonfatal convulsions and wild jumping reactions in groups of 20 DBA/1 mice 30 to 34 days old under four levels of white noise intensity.

Reaction	Sound pressure (db)			
	110	115	120	130
Fatal convulsion	0	10	25	30
Nonfatal convulsion	0	0	10	15
Wild jumping	35	65	75	95

against respective sound-pressure levels, a sigmoid function is strongly indicated. This conforms with the previous finding of Frings and Frings (*2*) of a sigmoid relationship between seizure incidence and intensity of a pure tone. A monotonic, negatively accelerated function is suggested when percentages of wild jumping reactions are plotted against sound-pressure levels. Chi-square tests show that the 110- and 130-db groups differ significantly at the 0.02 level or better with respect to frequencies of fatal convulsions, fatal and nonfatal convulsions together, and wild jumping reactions. Clearly, incidence of audiogenic reactions in DBA/1 mice is directly related to intensity of stimulation with white noise.

A final observation of interest is that none of the mice convulsed at 110 db in the present situation, although very high frequencies of seizures are obtained with sound pressures between 80 and 90 db with the bell-tub method (*4*). This is most probably due to differences in the frequency components of the stimuli used in the present study and in bell-tub experiments. One complex sound is not necessarily as effective as another complex sound, even though both have the same intensity.

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Social Aggressiveness in an Amphibian

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Problems of aggression have long occupied man, and they still appear to be in the forefront of importance. As one aspect of the total picture, the phenomenon of territoriality has attracted a large measure of interest from biologists in recent years, ever since it was effectively described by Howard (*1*) in birds. More recently, various workers have provided information on the extensiveness of territoriality, discussed the variations in its manifestation, indicated some of its functions, and refined our concept of it. Its significance as a feature of social behavior, as a regulator of population density, as an evolutionary factor operating in selection and in gene spread, and as a factor in promoting social well-being in various ways have all been shown or suggested by these investigations. Even so, much remains to be learned about it.

By territoriality is meant the defense of an area from invasion by another of the same species. This concept seems to be the most useful one and is generally accepted by workers in touch with its study. That some of the earlier, more restricted definitions are not adequate in the light of more recently gained information has been pointed out by several people over a period of years, as reviewed by Nice (*2*). Territoriality and the related phenomenon of maintenance of a home range were clearly separated by Burt (*3*), and their significant differences seem to allow no further confusion of the terms.

Among nonhuman animals, territoriality has been most intensively, as well as extensively, studied in birds, partly because of the ease of observation. However, it is known to be exhibited also by some species in other groups of animals—invertebrates, fish, reptiles, and mammals (*4*). To my knowledge, there had been no reported evidence of its occurrence in amphibians until Martof's suggestion (*4*) that a weakly developed sort of territoriality is exhibited by calling males of the frog *Rana clamitans* in breeding groups. The principal purpose of this paper is to report that a well-developed, aggressive territoriality is clearly demonstrated by the nonarboreal South American frog, *Phyllobates trinitatis* Boulenger. In the coastal mountains of northern Venezuela, this frog is common in the small streams about the Venezuelan Estación Biologica de Rancho Grande, near Maracay. Here, I observed it from Sept. 1951 to Jan. 1952 (*5*).

Territorialism was most frequently seen in adult females, which reach 28 mm in head-body length. They are a little larger than males and more brightly colored. The females have stations along the edges of streams, where each feeds in the daytime in a limited area, its home range, and seeks shelter, when alarmed, in a small opening beneath the rocks. Most of the home range, including the shelter site, is maintained as a territory from which the resident frog attempts to drive off intruders of the same species, usually with success.

The first aggressive act by the resident is usually a hopping approach to the intruder and a challenge, in which the bright yellow throat is exhibited and slowly pulsated. If the intruder does not retreat, the resident female makes a quick jump over the intervening few inchs and alights directly on the other animal, uusually on its back or head. In most instances, this is sufficient stimulus to cause the attacked frog to jump away, but sometimes the intruder will stand her ground, even to the point of defending herself. Then ensues an actual wrestling bout of several seconds, until one of the pair retreats or is pushed off the rock on which encounters often take place.

Only rarely was territorial defense identified in an adult male, but it was found to be carried out by young frogs, even by some that had only recently metamorphosed. The phenomenon was not associated with breeding or with the site of egg-deposition. Rather, it was a defense of feeding grounds and shelter (home) site. It was not a rare occurrence but

was seen repeatedly, exhibited by many individuals, obviously being a regular part of daily life. For example, on 19 Oct., in one period of 2.5 hr spent watching a small stream along 7 m of its length, five frogs were seen to defend their territories in the manner just described. On 22 Oct. at the same place, on the other hand, it was 2.5 hr before the full aggressive pattern was seen, although challenging behavior had occurred earlier.

A specific example of territoriality may be cited in the actions on 4 Oct. of a female, which had been watched in her territory on previous days as well. A subadult frog landed about 4 cm from her at the end of a jump. For 3 or 4 min the adult sat facing the young frog, with head elevated and anterior body raised high on straightened forelegs, slowly pulsating her orange-yellow throat through an amplitude of several millimeters. The smaller frog remained quiet. Then the resident jumped on the intruder, which made a short leap, dislodging the adult. Two more jumping attacks followed in rapid succession before the intruder hid beneath a rock. In a short time, the young frog came out and was quickly attacked again. This time its retreat carried it outside the territory of the resident female, and no further attack was seen.

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Oxidation of Indoleacetic Acid by an Extracellular Enzyme from *Polyporus versicolor* and a Similar Oxidation Catalyzed by Nitrite

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During an investigation in this laboratory concerning the action of the fungus *Polyporus versicolor* on lignin and various related phenolic compounds, it was noted that the culture filtrate was able to oxidize rapidly indole-3-acetic acid (IAA). Further work (*1*) was therefore done to characterize this enzyme and its reaction. The enzyme preparation was obtained by growing the organism for a 10-day period at 28°C in flasks of Dion's medium (*2*) on a rotary shaker and then dialyzing the culture filtrate for 9 days against daily changes of distilled water at 4°C. One-milliliter portions of this dialyzed filtrate, containing 1.20 mg of dry solids, were generally employed in the various experiments.

Measurements of gas exchanges in the Warburg apparatus at 37°C showed that 1 mole O_2 was used and 1 mole CO_2 was formed per mole of IAA during the reaction. This corresponds with the data reported for the IAA oxidase of pea seedlings (*3*, *4*), bean roots (*4*), and pineapples (*5*). The enzyme from *P. versicolor* showed optimal activity at about *p*H 4.5, compared with *p*H 6.5 for the enzymes from peas and beans and *p*H 3.5 for the enzyme from pineapples. Attempts were made to concentrate this fungus enzyme by methods used for other IAA oxidases, but precipitation by addition of 40 vol of acetone (*6*) inactivated and dialysis (*3*) failed to precipitate the enzyme. Heating for 10 min at 100°C effected complete inactivation. The reaction had a Q_{10} of 2.0 from 27° to 37°C. Riboflavin at a concentration of 10 μg/ml or higher produced no oxidation of IAA under the usual lighting conditions. The Q_{O_2} on various indole derivatives at a level of 10 μM was as follows: IAA, 153; indole-3-butyric acid, 68; indole-3-propionic acid, 28; and indole-3-acetaldehyde, 29 (see Fig. 1 for typical curves and conditions used). Phenylacetic acid, DL-tryptophone, DL-β-phenylalanine, indole, skatole, and indole-3-acetamide were not oxidized.

Hydrogen peroxide does not seem to be involved in the reaction, as is shown by the failure of either puri-

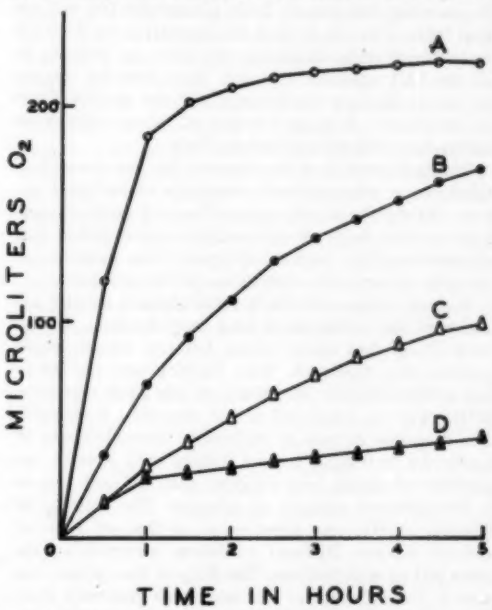

Fig. 1. Oxidation of (*A*) indole-3-acetic, (*B*) indole-3-butyric, and (*C*) indole-3-propionic acids present as the sodium salts, and of (*D*) indole-3-acetaldehyde by 1 ml of dialyzed culture filtrate of *P. versicolor*. Warburg vessels contained 10 μM substrate, 0.5 ml of M/5 sodium acetate buffer at *p*H 4.73, distilled water to 3.0 ml, and 0.1 ml of 25 percent KOH in center wells. Temperature, 37°C; gas phase, air.

fied catalase (*Kat. f.* 5400) or pyruvic acid to reduce the apparent uptake of O_2 by destruction of H_2O_2. No peroxidase activity could be detected in the filtrate by measurement of purpurogallin formed from pyrogallol in the presence and absence of H_2O_2, and a purified horseradish peroxidase (*P.Z.* 270) did not significantly alter the course of oxidation of IAA. The failure of the filtrate to oxidize cadaverine or putrescine indicated that no true diamine oxidase was present. An oxidation of *p*-phenylenediamine did not produce H_2O_2 and probably proceeded by means of hydrolytic deamination.

Up to 48-percent stimulation of the maximum oxidative rate on 10 μM IAA occurred with 0.001*M* $MnCl_2$, and various compounds produced the following percentage inhibitions: 0.01*M* azide, 100; 0.01*M* cyanide, 100; 0.1*M* semicarbazide, 100; 0.01*M* phenylhydrazine, 95; 0.01*M* fluoride, 87; 0.001*M* methylene blue, 86; 0.005*M* 2,4-dinitrophenol, 65; 0.01*M* 8-hydroxyquinoline, 47; 0.00015*M* $CuSO_4$, 46; 0.001*M* bisulfite, 40; 0.00005*M* 2,4-dichlorophenol, 36; and 0.005*M* iodoacetate, 31. This enzyme is similar to the enzyme from peas but not that from pineapples in inhibition by 8-hydroxyquinoline, and differs from both in being inhibited by 2,4-dichlorophenol instead of either no effect (*5*) or stimulation (*7*), respectively. It resembles the enzyme from pineapples (*5*) but not that from peas (*8*) in lack of stimulation by 0.0018*M* maleic hydrazide. Activation by Mn^{++} is common to all the IAA oxidases, although Mn^{++} does not appear to be an absolute requirement for the enzyme from *P. versicolor*. A large number of other compounds tested were without significant effect.

The end-product of the reaction has not been identified but is a tan-colored precipitate of carbonyl nature and may be a polymerized form of indole-3-aldehyde on the basis of theoretical considerations and various tests for higher aldehydes. The presence of bisulfite prevents the formation of this precipitate.

Sodium nitrite at 0.001*M* concentration greatly accelerated the oxidation of IAA enzymatically. It was soon found that nitrite alone, but not nitrate, could produce this oxidation. This reaction was similar to one of Salkowski's (*9*) color tests for IAA; however, HNO_2 was not employed in our situation. A straight-line response in rate to increasing concentrations of nitrite up to 0.002*M* and an uptake of 1 mole O_2 regardless of nitrite level suggests that this salt acts as a homogeneous catalyst in solution. The activity of 0.001*M* $NaNO_2$ was about equal to that of 1 ml of culture filtrate. Optimal oxidation occurred at the same *p*H as with enzyme. The R.Q. of the system was also 1. The influence of inhibitors was generally similar to that mentioned for the enzymatic reaction, except for failure of NaF to produce any appreciable inhibition. Heating did not inactivate nitrite alone in solution or added to filtrate. No nitrite could be detected in the filtrate by means of the sulfanilic acid-α-naphthylamine test (*10*), which was found to be sensitive to $1.65 \times 10^{-5}M$ NO_2, a level far too low to induce observable oxidation of IAA. The use of up to 80 μM of ammonium sulfamate to destroy NO_2 in the Warburg vessels had no effect on enzymatic oxidation but inhibited the catalytic oxidation by nitrite nearly 40 percent. No dehydrogenase activity of the enzyme could be demonstrated, but it was observed that IAA alone could slowly reduce methylene blue and that this reduction took place rapidly in the presence of nitrite. A cyclic shift from

$$HNO_2 \rightarrow HNO + H_2O \rightarrow H_3NO_2 \rightarrow HNO_2$$

may be responsible for such catalytic action.

Additional and more detailed data regarding the IAA oxidase from this new source will be published elsewhere.

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11 March 1954.

Adsorbability of Bacteriophage T_1 after Ultraviolet Irradiation in the Dry State

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It has been reported previously that phage T_1, after ultraviolet irradiation in the dry state, cannot be photoreactivated (*1*). Since photoreactivation requires that the phage be adsorbed to its host, *Escherichia coli* strain B, it is possible that the simultaneous combination of dryness and ultraviolet impairs the adsorbability of the phage (*2*). Therefore, this property was investigated (*3*).

A stock of T_1 labeled with P^{32} was prepared (*4*) in the following manner: *E. coli* strain B from an overnight slant culture and phage from a broth stock were added to peptone-glucose medium (*5*) in final concentrations of 1×10^8 bacteria and 1.5×10^4 phages/ml; P^{32} was added so that the final concentration was 144 μc/ml, and the suspension was aerated at 37°C. After preliminary centrifugation at 3200 rev/min, to eliminate bacterial debris, two ultracentrifugations were carried out. The first pellet was resuspended in 2-percent ammonium acetate and the second in broth. Radioactive assays were made of (i) the original P^{32} solution, (ii) the acetate suspension after the first ultracentrifugation, (iii) the acetate supernatant, and (iv) the final broth suspension. This was done by drying 1-ml samples in planchettes and counting with an end-window type of Geiger counter.

Table 1. Radioactivity at various stages in purification of P^{32}-labeled T_1.*

Material	Volume (ml)	Counting rate† (counts/min ml)	Counting rate corrected to 10 ml volume (counts/min ml)
Original aeration tube	24	3.32×10^7	7.94×10^7
Ammonium acetate suspension after first ultracentrifugation	15	2.00×10^6	3.00×10^6
Ammonium acetate supernatant after second ultracentrifugation (later decanted)	15	5.56×10^5	8.35×10^5
Final broth suspension	10	1.90×10^6	1.90×10^6
Expected final counting rate = $(3.00 \times 10^6) - (8.35 \times 10^5)$ = 2.17×10^6 counts/min ml.			

* Phage titer in final broth suspension = 8.73×10^{10} T_1 particles/ml; maximum counting rate per phage = $1.90 \times 10^6 / 8.73 \times 10^{10} = 2.18 \times 10^{-5}$ counts/min; maximum original activity incorporated into phage = 2.4 percent.
† One microcurie gave 2.3×10^6 counts/min.

Results are summarized in Table 1. The final concentrations of P^{32} activity per phage and per milliliter of broth were calculated to be 1×10^{-10} μc/phage and 8.2 μc/ml. These activities were not high enough to give significant killing as was shown by the fact that a reassay of the phage in the final suspension, 1 mo after its preparation, showed no change.

The possibility that a significant fraction of the P^{32} activity was still in the medium outside of the phage must be considered. If it is assumed that, at the worst, only 80 percent of the activity in the ammonium acetate supernatant was discarded and 20 percent left behind after decantation, then calculation utilizing the values in Table 1 shows that no more than 8 percent of the total final activity would be in the medium. Adsorption of activity in excess of this would be due to adsorption of radioactive phage rather than to removal by bacteria of radioactive phosphate from the outside medium (*6*).

The final broth suspension was used to prepare four samples of spray-dried phage on cover glasses (*1*). Two cover glasses were dropped into 5-ml broth without previous ultraviolet irradiation and two were irradiated for 120 sec each. All four broth suspensions were then assayed for dark and light survival.

"Wet" radioactive controls were then prepared as follows. The labeled stock was diluted 1 : 24 in phosphate buffer (*7*). A sample of this suspension was exposed to ultraviolet radiation for 120 sec. Nonirradiated and irradiated phosphate buffer suspensions were diluted further into broth by a factor of 10 and assayed for dark and light survival. The two dilution factors were calculated to give equal concentrations of phage (active and inactive) in all broth samples.

The six broth suspensions were used to test adsorbability. Each sample was tested as follows: 1 ml of the broth suspension was added to 2 ml of a suspension of *E. coli* B in phosphate buffer at 37°C (final bacterial concentration, 1.6×10^8); at 5 min, 1 ml was removed for P^{32} assay; at 6 min, 0.05 ml was diluted into 5-ml broth for assay of dark and light survival; at 7 min, the remainder was centrifuged at 3200 rev/min for 4 min; 1 ml of the supernatant was then removed for P^{32} assay.

Table 2 shows the results. There is no photoreactivation for the two samples containing dry-irradiated phage, whereas the sample irradiated in phosphate buffer shows a light survival almost 20 times the dark survival. The radioactive counting rates are so high that statistical error is negligible. All six samples show an adsorption of radioactivity much more than 8 percent. They are all nearly the same, giving about the 40 percent to be expected. Hence, it appears that impairment of adsorbability is not responsible for the impairment of photoreactivability in dry-irradiated phage T_1.

Table 2. Relationship between photoreactivability and adsorbability for T_1 irradiated with ultraviolet light while "wet" and while "dry."

Sample	T_1 assays of adsorption tube		Dark survivors (percent)	Light / Dark	Counts/min ml of adsorption tube	Counts/min ml of supernatant	P^{32} adsorbed (percent)
	Dark	Light					
Dry-control	$3.12 \times 10^{8*}$		100		2045	1255	39
Dry-control	$2.64 \times 10^{8*}$				2255	1520	33
Dry-irradiated	3.06×10^6	3.12×10^6	1.1	1.0	2035	1235	39
Dry-irradiated	2.40×10^6	2.01×10^6	0.83	0.84	1915	1105	42
Wet-control	3.45×10^5		100		2735	1585	42
Wet-irradiated	2.13×10^6	4.02×10^7	0.62†	19	2665	1550	42

* The values of these controls average 2.88×10^8.
† This reduction in dark survival is not due to an increase in the ultraviolet inactivation cross section. The corresponding survival, as measured in the broth suspension before dilution into the adsorption tube, is 1.2. The observed reduction may be due to "abortive infection" (*8*).

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Preparation of Soluble Monoamine Oxidase

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Since its discovery in 1928 (*1*), monoamine oxidase (*2*) has stubbornly resisted various attempts at purification (*1, 3, 4*). An explanation for this behavior emerged from the demonstration of the enzyme's intimate adherence to the cytoplasmic particulate elements (*5*). Various efforts were subsequently made to release this system into solution by means of disruption of these bodies. The result was either loss of activity or the production of smaller microscopic particles to which in turn the enzyme was attached (*6*). Such experiences strengthened the earlier opinion that "monoamine dehydrogenase" was part of a complex of several enzymes acting in unison or in sequence (*4, 7*), in a fashion parallel to that postulated in the case of succinic dehydrogenase (*8, 9*).

In order to achieve dissociation of this labile deaminase from the insoluble cytoplasmic residue in liver dispersions, some extraction procedures were reinvestigated (*10*). Morton's method (*11*) yielded an inactive aqueous phase with activity still bound to the tissue fragments that were drawn into the butanol. Extraction with ethyl ether merely forced the activity-rich particles to align themselves at the interphase, while mixtures of ether and alcohols caused irreversible inactivation, even in the cold. On screening a number of surface active agents, however, a surprising tolerance of this oxidase toward many commercial soaps and detergents became apparent. Three of these agents actually caused enhancement of the deamination rate (*12*) of tyramine by rat and rabbit liver homogenates in phosphate buffer. The increment of activity, in the presence of isooctylphenoxypolyethoxyethanol (*13*), polyoxyethylenelauryl alcohol (*14*), and Alconox® ranged in one experiment from 60 to 25 percent, in that order.

Isooctylphenoxypolyethoxyethanol, in addition to increasing the average reaction velocity more effectively than the others, also produced a striking translucency of the homogenates. Maximal clearing occurred as rapidly as 60 sec after addition of the alcohol. The performance and the appearance of the homogenates remained thereafter virtually unchanged, even after they had been stored for 3 days at room temperature. This long-chain alcohol was therefore used in more detailed investigation.

Variation of detergent concentration from 1 to 70 percent changed very slightly either the degree of clearing or the activity of a 20-percent rabbit liver homogenate. Routine use of a 5-percent (V/V) concentration was arbitrarily adopted for all subsequent tissue preparations.

Centrifugation of the treated homogenates at 2000 *g* for 30 min yielded a small volume of sediment that was poor in monoamine oxidase activity, while brisk activity was demonstrable in the supernatant. The untreated homogenates presented, as was expected (*5*), the opposite distribution, with the voluminous sediment containing almost all the activity. The picture was not significantly changed when centrifugation at 144,000 *g* (calculated for the bottom of the tubes) was allowed to proceed for 180 min. This higher centrifugal force did cause the accumulation of a waxy material on top of the sparkling clear supernatant. This waxy layer was poor in activity and was discarded in subsequent experiments.

Clear supernatants were centrifuged at 144,000 *g* in some experiments for several hours at about +4°C (*15*), followed by lowering of the temperature, without changing the centrifugal force. The contents of the tubes became solidified and were cut into several segments. Assay of fractions secured in this manner showed that a slow sedimentation of the enzyme had taken place. After removal of a firm, pasty pellicle of heavy, inactive material, the lowest segments had 25 percent higher activity than the uppermost.

The specific gravity of nonfractionated, active supernatants was of the order of 1.016 to 1.018. Sucrose solution, the medium widely employed in 0.88*M* concentrations for centrifugal isolation of intracellular components, had a specific gravity of 1.120. It has already been established (*11*) that particles of microsome size are sedimented out of this medium following centrifugation at 41,000 *g* for 2 hr. It would seem doubtful, therefore, whether any such submicroscopic granules could have remained in suspension following our protracted centrifugation at higher speeds, in a medium of lower specific gravity, and in the presence of phosphate buffer, which is known to cause these particles to aggregate. Furthermore, it was also demonstrated that the liver microsomes disintegrate on exposure to the detergent: the silky appearance of suspensions of isolated microsomes (*16*) was instantly lost on exposure to this agent, and an orange-red color appeared, which was due possibly to the release into solution of cytochromes. Recentrifugation showed little discernible sediment. Similar results were obtained in the case of washed rat liver mitochondria.

Other tissue enzymes, as well, were brought into solution by this procedure. Assays for acid and alkaline phosphatase, diamine oxidase, D-amino acid oxidase, and histaminase showed high activity in liver extracts of this type. Our experience with succinic oxidase, on the other hand, was in striking contrast.

The latter system became completely inactivated upon exposure to the long-chain alcohol. This held true even when all the precautions necessary for vigorous succinic oxidase action (*9*) were strictly observed and the activity was measured by two different methods (*17, 18*). This finding is in accord with recent experiences and others (*19*) and certainly argues against the postulation of a succinic oxidase-like complex as an explanation for some of the past difficulties in handling monoamine oxidase.

Irrespective of this theoretical consideration, the profound change in the physical status of monoamine oxidase consequent to the treatment outlined in foregoing paragraphs has some practical implications. It should now be feasible to obtain preparations of monoamine oxidase pure enough for physiological and therapeutic investigation (*4*).

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23 February 1954.

Reversible Induction of Sexual Differentiation in *Hydra*

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The chemical nature of the stimulus that induces sexual differentiation in *Hydra* has long been of interest to investigators. Since sexual differentiation in these animals is not an obligatory phase in their life-cycle, which can be continued indefinitely by the asexual mechanism of budding if necessary, some environmental stimulus reversibly controls their sexual differentiation so that the interstitial cells of the ectoderm develop into spermaries and ovaries at certain times and not at others (*1–4*).

* With the technical assistance of John H. Kirhoffer.

Previous workers have reported that sexual specimens of *Hydra*, usually found in nature in the fall or winter, appear from time to time in laboratory cultures without apparent cause (*5*). Descriptions of the inducing circumstances have mentioned four variables: changes in *temperature*, both upward (*4, 6*) and downward (*1–3, 5*); changes in the degree of *stagnation* of the cultures (*7, 8*); changes in the state of *nutrition* varying from starvation to overfeeding (*9, 10*); and changes in the degree of *crowding* of the cultures. It is interesting to note that this last factor has been observed to be associated with sexual differentiation in the ciliate *Glaucoma scintillans* (*11*) as well as in Cladocera (*12*). No common mechanism by which these different variables may operate has yet been proposed.

In a recent report from this laboratory, it was noted that *Hydra* grown under controlled conditions increased asexually in strictly logarithmic fashion (*13*). Subsequently studies have shown that the rate of this logarithmic increase is a function of five variables (*14*) when, and only when, the cultures were grown in very shallow (4 mm) culture in Petri dishes. The necessity of maintaining highly aerobic conditions if reproducible results (±5 percent) were to be obtained was especially apparent with cultures grown above room temperature, allowed to stagnate for days in the same water, heavily fed with living crustaceans or densely crowded. Since these same conditions had been described as associated with the induction of sexual differentiation in *Hydra*, it suggested that the actual stimulus might consist of a critical lowering of the oxygen tension of the medium.

Direct determination of the oxygen tension presented a problem at first, because the Winkler method of measuring dissolved oxygen requires water samples as large as 250 ml, while its microadaptations are unduly time consuming. Fortunately it was found possible to devise a colorimetric method for 0.5-ml samples that could be completed in about a minute (*15*). The availability of this new method made it possible to observe the oxygen concentration in all cultures of *Hydra* and especially in those that differentiated sexually when maintained under a variety of conditions of temperature, stagnation, nutrition, and crowding. It was found without exception in more than 30 cases that the oxygen concentration in such sexual cultures was reduced below 8 mg/l O_2 (*16, 17*), but not below about 4 mg/l O_2. The most effective concentration, in terms of both rapidity and percentage of sexual forms induced, seemed to be about 6–7 mg/l O_2. Highly aerobic cultures (>8 mg/l O_2) continued to bud asexually, while anaerobic ones (<1 mg/l O_2) neither budded nor developed sexual organs. Experimental cultures maintained between 5 and 8 mg/l O_2 by the daily addition of appropriate amounts of fully aerated water developed sexual specimens repeatedly within about 14 days at room temperature.

Evidence that neither temperature, stagnation, nutrition, nor crowding were involved *per se* was obtained by holding these factors constant and varying

the oxygen concentration of the medium. This was accomplished by placing the same number of *Hydra* in each of a series of half-filled serum bottles hermetically sealed with rubber stoppers through which varying amounts of air could be withdrawn by means of a syringe and hypodermic needle. After 3 wk without feeding at 20°C, during which time no asexual increase occurred, testes were observed on 90 percent of the *Hydra* in the serum bottle whose atmospheric pressure had been reduced 20 percent to 608 mm of Hg. No sexual forms were observed in control cultures exposed to the air in shallow vessels or in serum bottles evacuated below 388 mm pressure.

These results were confirmed by keeping shallow cultures (4 mm deep) of *Hydra* in Petri dishes placed within vacuum desiccators where the partial pressure of oxygen could be adjusted to any desired level by means of a water aspirator attached to a mercury manometer (*18*). Testes were observed in 17 days at 23°C in cultures fed twice a week and maintained at 610 mm of Hg, while none were observed in cultures maintained at either 760 mm of Hg or below 532 mm of Hg pressure.

Additional evidence was obtained by allowing a clone of *Hydra* to increase asexually under uniform conditions of temperature, stagnation, and nutrition until the crowding had increased to a point, critical for each vessel and depth of medium, where the average oxygen concentration had fallen to about 6–7 mg/l O_2. Once this critical density had been reached, further asexual increase was inhibited and sexual forms appeared. Since routine oxygen determinations are not required in this method, it is convenient and has been used successfully with both male and female clones (*19*) at 20°, 25° and 30°C.

When the resulting sexual *Hydra* were returned to fully aerobic conditions in shallow Petri dishes, they did not revert back to the asexual state but continued to develop spermaries and ovaries at the same time that they budded asexually. Since these buds spontaneously became sexual within a few days, a permanently "sexual" culture became possible, one that has maintained a high degree of sexuality for more than 5 mo under the identical culture conditions used in maintaining the usual "asexual" cultures (*13*). This apparently permanent modification of the phenotype by environmental conditioning represents a further example, it would seem, of *Dauermodifikationen* as recently discussed by Sonneborn (*20*). Its reversibility was demonstrated by reducing the oxygen tension to about 2.5 mg/l O_2 using the vacuum desiccator method described. Under these conditions, the growth of sexual organs was specifically inhibited within about 10 days, while asexual reproduction by budding continued as before.

These results appear to indicate that the primary stimulus that induces sexual differentiation in *Hydra littoralis* is a critical lowering of the oxygen concentration of the medium. This state of partial anaerobiosis may be induced in turn by external conditions such as are found during winter anaerobiosis in ponds (*21, 22*) or internally within a clone by simple crowding. Whether these factors are involved in the environmental induction of sexual differentiation in other species of *Hydra, Volvox,* sponges, rotifers (*2*), Cladocera (*12*), protistans such as the ciliate previously mentioned (*11*) or the malaria plasmodium (*23*), or even in aggregating myxamebas (*24*), and so forth, only further work can determine.

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Toxicity of Peptides of Thienylalanine for Rats

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Certain peptides containing the amino acid analog, β-2-thienylalanine, have been reported to inhibit the growth of bacteria (*1*). It has been further reported that a proteolytic enzyme, carboxypeptidase from beef pancreas, hydrolyzed carbobenzoxyglycyl-β-2-thienylalanine *in vitro* at the terminal peptide bond to liberate β-2-thienylalanine (*2, 3*). It therefore seemed of interest to determine the effect of peptides containing thienylalanine upon the growth of rats, with the hope of gaining some evidence concerning the ability of enzymes of the animal to hydrolyze the peptides *in vivo*.

Several workers have reported the toxicity of β-2-

Table 1. Inhibition of the growth of rats by β-2-thienylalanine and its derivatives; reversal of inhibition with phenylalanine.

Rat*		Supplement to basal diet (%)	Initial weight (g)	Final weight (g)	Days	Average gain per day (g)
17	2	β-2-Thienylalanine	130	115	11	− 1.4
	2	β-2-Thienylalanine *plus* 1 phenylalanine	115	130	10	1.5
30	2	β-2-Thienylalanine	214	136	24	− 3.2
	2	β-2-Thienylalanine *plus* 1.6 phenylalanine	136	162	10	2.6
10	1.6	Glycyl-β-2-thienylalanine	137	117	14	− 1.4
4	2	Glycyl-β-2-thienylalanine	195	159	5	− 7.2
38	2	Glycyl-β-2-thienylalanine	279	218	20	− 3.0
	2.7	Glycyl-β-2-thienylalanine *plus* 1.6 phenylalanine	218	230	4	3.0
41	1	Chloroacetyl-β-2-thienylalanine	68	70	8	0.25
3	2	Chloroacetyl-β-2-thienylalanine	115	91	11	− 2.2
	2	Chloroacetyl-β-2-thienylalanine *plus* 1 phenylalanine	91	80	4	− 2.75
	2	Chloroacetyl-β-2-thienylalanine *plus* 2 phenylalanine	80	72	4	− 2.0
37	2	Chloroacetylphenylalanine	124	91	11	− 3.0
	2	Chloroacetylphenylalanine *plus* 1 phenylalanine	91	86	4	− 1.25
	2	Chloroacetylphenylalanine *plus* 2 phenylalanine	86	77	4	− 2.25
37a	1	Chloroacetic acid	185	116	5	−14.0
7	2.1	Carbobenzoxyglycyl-β-2-thienylalanine	136	128	14	− 0.6
47	4.2	Carbobenzoxyglycyl-β-2-thienylalanine	294	195	20	− 5.0
	4.2	Carbobenzoxyglycyl-β-2-thienylalanine *plus* 1.6 phenylalanine	195	186	6	− 1.5
20	1	Carbobenzoxyglycine	200	223	4	5.8

* Other animals were used in each study, but these are reported as typical.

thienylalanine for rats and the ability of phenylalanine to reverse the toxicity (*4, 5*). The work (*6*) reported here shows that some peptides containing thienylalanine are as toxic as free thienylalanine; the toxicity of some of these peptides is relieved by phenylalanine. In the cases where the peptide toxicity is identical with that of free thienylalanine and is relieved by phenylalanine, it seems reasonable to suggest that the toxicity of the peptide results from the formation of thienylalanine by enzymatic hydrolysis of the peptide. On the other hand, in the cases where the thienylalanine derivatives are not toxic or where the toxicity is not reversed by phenylalanine, it seems reasonable to conclude that such peptides are not hydrolyzed to any appreciable extent to produce thienylalanine.

Table 1 summarizes the effect of the compounds studied upon the growth of rats. It is evident that glycyl-β-2-thienylalanine was similar to free β-2-thienylalanine in its toxicity for the rat; the toxicity was reversed by phenylalanine. Apparently, glycyl-β-2-thienylalanine was hydrolyzed by some peptidase of the rat to liberate the free amino acids, glycine and β-2-thienylalanine.

Chloroacetyl-β-2-thienylalanine and carbobenzoxyglycyl-β-2-thienylalanine inhibted growth of the rats, but the inhibition was not reversed by phenylalanine at the levels tested. This indicates that the toxicity was not the result of the formation of free thienylalanine but might be caused by the peptide itself or by some other product of hydrolysis. Enzymatic hydrolysis of carbobenzoxyglycyl-β-2-thienylalanine at the terminal peptide bond would produce carbobenzoxyglycine and β-2-thienylalanine. Since carbobenzoxyglycine was not toxic, and since the toxicity of this peptide was not reversed by phenylalanine, the conclusion is that carbobenzoxyglycyl-β-2-thienylalanine was not hydrolyzed to any appreciable extent by the rat.

The toxicity of chloroacetyl-β 2-thienylalanine and chloroacetylphenylalanine were of the same order, and free phenylalanine did not reverse the toxicity. Since chloroacetic acid was found to be highly toxic, it was concluded that the chloroacetyl amino acids might be hydrolyzed to produce chloroacetic acid. This conclusion is supported by the unpublished finding that carboxypeptidase can hydrolyze chloroacetylphenylalanine and chloroacetylthienylalanine *in vitro* at the same rate.

These studies were conducted upon male rats fed a diet of commercial rat chow. The compounds tested were uniformly mixed with the chow by grinding. In preliminary experiments, it was found that a diet containing 2 percent thienylalanine in the commercial chow inhibited growth to the same extent as that reported by Ferger and Du Vigneaud (*4*) using 2 percent thienylalanine in a synthetic diet.

All compounds tested were of the racemic variety.

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A Methodological Refinement in the Study of "ESP," and Negative Findings

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A recent improvement in the study of extrasensory perception ("ESP") has been the use of tables of random numbers in the shuffling of target-items (*1–3*; cf. *4*). Despite this increased rigor, however, there continue to be reported small, but statistically significant, deviations from "chance expectancy."

These findings raise the suspicion that tables of random numbers may not be entirely random; that such tables may, in some small degree, actually embody conventional preferred sequences of digits. There is some ground for such a suspicion in the mode of construction of the most widely used of these tables (*5*), which was carefully checked and adjusted to insure "randomness." Furthermore, there is available Brown's (*6*) recent observation that

> . . . statistically significant results similar to those of psychical research are obtainable simply by making selections in published tables of random numbers as if the tables were themselves the data of a psychical research experiment. This procedure . . . produced . . . results which differed from the mean expectation by more than three standard deviations.

It should be of interest to determine whether or not "ESP" manifests itself in the face of an experimental methodology that avoids the pitfalls of "randomness." The investigation reported here attempted such a determination.

Two targets were prepared. Each target consisted of a sheet of 8.5×11-in. paper bearing 25 items in five rows of five items each. Each item consisted of a pair of ¼-in. squares, of which either the right-hand square or the left-hand square was blacked in. In point of fact, one target was constructed by filling in the left-hand square in *every* item, and the other target by filling in the right-hand square in *every* item. The targets were sealed in identical opaque envelopes, independently shuffled, and given arbitrary designations. They were not unsealed and identified until after all experimental responses had been tabulated.

Mimeographed response-sheets were also prepared. Each sheet bore a pattern of items exactly like that of the target-sheets, except that, of course, none of the squares was blacked in. Instructions at the head of each response-sheet directed the subject to work in privacy and in an atmosphere of relaxation, and to fill in the items as he thought they were filled in on the target to be assigned to him. The instructions also cautioned the subject not to be surprised by the manifestation of an unusual target-pattern.

Finally, a brief mimeographed questionnaire was devised. By advance decision, only one of its questions was considered material ("Do you think that extrasensory perception ever actually occurs?"); the remaining, related, questions were intended to serve as buffers.

The subjects were 540 students of both sexes distributed among 14 classes in introductory psychology. Each class was addressed by the same experimenter at the beginning of a class-hour. Briefly and sympathetically, he outlined the history of "ESP." The questionnaires were then distributed, filled out by the students, and re-collected by the experimenter.

The experimenter now left the class and proceeded to sort the returned questionnaires to identify subjects who were believers and subjects who were nonbelievers in "ESP." Names of believers and names of nonbelievers were alphabetized separately; then, for each subject whose name appeared in an odd-numbered position on either list, a response-sheet assigning "the target in Old Main Building" was prepared; for each of the remaining subjects, a response-sheet assigning "the target in the Library" was prepared. The experimenter now returned to the class, distributed the response-sheets, explained exactly where the targets were located, and requested that the completed response-sheets be returned at the next class meeting. Individual scores were promised (and subsequently furnished), and class interest was high.

Table 1. Mean number of leftward choices in each experimental subgroup and associated statistics.

	Target assigned		Difference-statistics	
	Rightward	Leftward		
Believers	N = 186 M = 13.06 SD = 2.34	N = 186 M = 13.22 SD = 1.81	D = +.16 (P = .46)	D = +.54 (P = .34)
Nonbelievers	N = 44 M = 12.95 SD = 2.95	N = 44 M = 12.57 SD = 1.76	D = −.38 (P = .47)	
All subjects	N = 230 M = 13.04 SD = 2.46	N = 230 M = 13.10 SD = 1.82	D = +.06 (P = .76)	

All P-values arise from two-tailed tests of the null-hypothesis. Other symbols have their conventional meanings (N, number of cases; M, mean; SD, standard deviation; and D, difference).

The targets were rotated between the locations, and subjects were eliminated from consideration by means of a table of random numbers (considered adequate for this purpose), in such a fashion that finally: (i) in each class, equal numbers of believers had responded to each target, and equal numbers of nonbelievers had also; and (ii) over-all, equal numbers of believers had responded to each target in each position, and equal numbers of nonbelievers had also. There now remained 372 believers and 88 nonbelievers, a total of 460 subjects.

Each subject's response-sheet was scored for *the number of items in which the left-hand square was blacked in*. If "ESP" exists in the general population, as has been recently alleged (*1–3*), one would expect distinctly more leftward choices in response to the leftward target, distinctly fewer in response to the rightward target, and thus a distinct and significant difference between the mean scores for groups responding to the two targets.

The mean number of leftward choices among all 460 subjects was 13.07, a figure very significantly different from the "chance" expectancy of 12.50 ($P < .0_51$). The mean number of leftward choices in each of the subgroups is indicated in Table 1, and it will be seen that the means of the subgroups closely approximated the over-all mean. Neither among believers, nor among nonbelievers, nor among all subjects taken together was the mean number of leftward choices significantly related to the nature of the target assigned. It is true that the differences found among believers and nonbelievers, respectively, although insignificant, were in the opposite directions sometimes hypothesized (*2, 3*; cf. *1*); however, a test of the difference between these differences showed it also to be statistically unreliable (final column, Table 1).

Under the conditions of this investigation (which summated the responses of a large number of subjects to balanced, systematically nonrandom targets), there arose no evidence whatsoever that "ESP" does in fact exist. Discovered incidentally was a general preference for left-hand choices, a preference that might have been misleading in the context of another experimental design.

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Communications

Etymology of Autoradiography

Scientific techniques are often named carelessly by experimenters more interested in precision of results than in precision of communication. Once started, etymological errors are easily perpetuated. Such is the situation for the technique of locating and measuring radioactivity by placing a radiation source in contact with or in proximity to a photographic emulsion, followed by exposure and development of the emulsion. Many names have been applied since Becquerel first used the technique in 1896. Among them are *autoradiography* (*1, 2*), *radio-autography* (*3*), *curiegraphy* (*4, 5*), *radiumgraphy* (*4*), *and photography by local application* (*5*). Terms for the results of the techniques have been *autoradiograph* (*2, 6*), *radioautograph, autophotograph* (*7*) *autoradiogram* (*1*), *radium gram* (*2*), *radiograph* (*2, 6*), *organoradiumgraph* (*5*), *curiegraph* (*5*), *cliché radiographique* (*2*), *microradioautogram* (*8*), *autograph* (*9*), *radiograph* (*10*), *historadiograph* (*11*), *radiogram* (*2*), and *histoautoradiograph* (*6*). One author (*2, 6*) used five terms in a single paper to indicate this technique. It is perhaps time to eliminate this confusion.

Since these words are, for the most part, derived from the Greek, it is preferable to be consistent within the system of word-building from that source. Although the ancient Greeks would probably not have used any of these terms, since they seldom employed more than two stems, three-stem words are correct and have their value in modern English. Multiple-stem words enable classification of ideas. For example, *prorubricyte, rubricyte,* and *metarubricyte* (*12*) classify red blood cells according to their age.

Similarly, in the class of radiographic techniques, we already have *gamma radiography* and *x-radiography. Autoradiography* then is a third member of the class—the descriptive prefix, *auto-* (self), being added in the same sequence to give autoradiography.

Another argument for autoradiography is that *auto-* acts in Greek as a prefix and is therefore very seldom found in the middle of a word. This logic eliminates the term *radioautography* unless one wishes to think of the technique as belonging in the class with autography. However, it does not seem logical to place the technique in the same category with the writing of one's signature. Another argument against radioautography is that four vowels—*i, o, a, u*—occur together. This should be avoided because of possible phonetic difficulties. *Curiegraphy,* named after Madame Curie, is not sufficiently descriptive and its use had but limited vogue. It is of historical interest only.

Autophotography implies visible radiation and thus is not suitable for radioactive radiation. Because of the wide application of *autoradiography*, it will undoubtedly be necessary to qualify the term by the use of prefixes to distinguish its various phases—such as *micro-*, *macro-*, or *histo-autoradiography*. When necessary, this would seem to take advantage of the ability of Greek to lend itself to the logical classification of ideas.

The verb stem, *-graph*, is derived from *graphein* (to write or to draw). Thus by performing the technique, one autoradiographs. The result from this action—that is, the developed film or plate—is a *-gram*. This noun stem is derived from the Greek noun *gramma*, meaning something that has been written or drawn. *Autoradiogram* is correct, notwithstanding a photograph produced by photography. Etymologically, this result should be a *photogram* and the camera a *photograph*. Wide and consistent usage of this error has made these two terms acceptable. Not so for autoradiograph, since the usage has been neither so widely nor so consistently used. It does not seem appropriate that autoradiograph as a noun should be similarly perpetuated by scientists.

It might be argued that *graph* could be derived from the adjective *graphic* (pertaining to writing or drawing). To use *autoradiograph*—that is, self-ray-writing—is to employ it in its adjectival sense [*cf.* I sent the message by telegraph(ic) instrument] whereas a genuine noun use is desired. The *-gram* ending accurately provides this by its meaning, the result of an action. Another objection to *autoradiograph* as a noun form is the tendency to delete the *radio-*, producing *autograph*, which means a person's signature. However, *autogram* is a convenient nickname for autoradiogram and does not cause confusion. (Fischer (*5*), by the way, used *autophoto* as such a nickname.)

Therefore, we recommend the terms *autoradiography* to designate the technique, and *autoradiogram* to designate the result of the technique.

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A Concise Form for Scientific Literature Citations

A single issue of a modern scientific journal or book often contains thousands of literature citations. In view of the large total space thus consumed, it would appear worth while to adopt a more concise style for such citations than that now customary. Table 1 demonstrates a proposed new style, which would reduce the minimum linear space requirement for each citation by about one-half and would save time and labor for the authors, editors, and users of scientific literature. Although Table 1 is largely self-explanatory, certain features require comment.

Items regularly included. The minimum information necessary in principle to specify a certain article (or page of an article) consists of the page number, journal name, and year number. These items would be handled as follows:

The left-hand number in each new-style citation (Table 1) is the page number, consisting usually of one to four digits.

The set of capital letters in each citation is the code for the journal name. For the most important journals, these letters could be so chosen as to suggest the name, but this is not essential and would not be possible for all journals. With four letters, 26^4 or 456,976 different journal codes can be assigned. This number should be more than ample, not only for all scientific journals published in the world at present, but also

Table 1. Comparison of conventional and proposed concise form for some typical literature citations.

Ref. No.	Conventional form	Concise form
(1)	*Helv. Chim. Acta* **26**, 2266 (1943)	2266-**HCAC**-43
(2)	*Ann.* **3**, 132 (1832)	132-**DANN**-832.3
(3)	*J. Biol. Chem.* **188**, 287 (1951)	287-**AJBC**-51.8
(4)	*Bull. Soc. Chim.* [4] **19**, 327 (1916)	327-**FBSC**-16.9
(5)	*J. Am. Chem. Soc.* **72**, 4077 (1950)	4077-**ACSJ**-50
(6)	*J. Chem. Educ.* **27**, 654 (1950)	654-**AJCE**-50
(7)	*J. Org. Chem.* **13**, 697 (1948)	697-**AJOC**-48
(8)	*Chem. Abs.* **40**, 6512 (1946)	6512-**ACAB**-46
(9)	*Bull. Chem. Soc. Japan* **10**, 424 (1935)	424-**KBCS**-35
(10)	*Science* **119**, 135 (1954)	135-**ASCI**-54.9

Table 2. Suggested code letters for a few journals.

Code	Journal	Code	Journal
ACAB	*Chem. Abs.*	**BSOC**	*J. Chem. Soc.*
ACSJ	*Jour. Am. Chem. Soc.*	**DANN**	*Annalen (Liebig's)*
		DBER	*Ber.*
AIEC	*Ind. Eng. Chem.*	**DMON**	*Monats.*
AJBC	*Jour. Biol. Chem.*	**FBSC**	*Bull. Soc. Chim.*
AJOC	*J. Org. Chem.*	**HCAC**	*Helv. Chim. Acta*
ASCI	*Science*	**RJPC**	*J. Phys. Chem. U.S.S.R.*
BBIO	*Bio. J.*		

for journals which have been discontinued, or which may be started during the next century or two.

Each right-hand number (Table 1) is the year number, consisting usually of two digits—for example, –48 for 1948. For the unusual reference a century or more old at the time of citation, three digits would be needed—for example –832 for 1832. Note, however, that an 1886 reference cited in 1954 would read simply –86.

The separation of the two numbers of each citation by letters insures legibility with minimum punctuation. In printed material, the journal code letters should appear in boldface or italics.

Optional items. Although not essential, it would be convenient to let the first letter of each journal code designate the country of publication—for example the H in **HCAC** (Table 1) signifies Switzerland. Each of the eight or ten major scientific countries would receive an individual letter and where necessary additional alternate letters, and all remaining countries or territories would be covered by six continental code letters. If the first letter of every code were used to designate country, the remaining three letters would cover 17,576 journals for each country, thus only the two or three largest countries should require more than one letter (Tables 2 and 3). It would, of course, be possible to use journal codes containing a total of five letters, if four-letter codes should ever in the future become inadequate.

The proposed journal code system may be compared to the very successful international system of radio call letters, which for example assigns initial letters **W** and **K**, to United States broadcasting stations.

It might ultimately prove desirable to let the second letter of each journal code designate the field of science (for example, C for chemistry), but this problem need not now be considered in detail.

Items regularly omitted. The authors and title are unnecessary in a minimum citation but can, of course, be included as supplementary information whenever desired. Certain other items are, in principle, entirely unnecessary and could in time be abandoned if journal editors would arrange to do so.

The series number of any journal is fixed by its year number and thus can always be omitted; for example, any 1916 issue of the *Bull. Soc. Chim.* (**FBSC**) necessarily belongs to series 4.

Volume numbers are superfluous for any journal that has adopted the very sensible one-volume-per-year system. The *Journal of the Chemical Society* (**BSOC**), for example, has not used volume numbers since 1926. (In some other cases one-volume-per-year journals continue to use volume numbers merely from tradition.) Issue numbers have already been abandoned by most scientific journals, since pagination through a year (or volume) is now usually continuous.

Historical information regarding the number of preceding years, volumes, series, and so forth, could easily be given by each journal in its annual title page, thus eliminating the need to clutter up literature citations with such information.

Temporary procedure for multivolume journals. Since many journals still do have more than one volume per year, and in any event occasional references to back years of such journals will always be necessary, citations must sometimes specify both year and volume. The problem can be solved by appending the last digit (if necessary, last two digits) of the volume number to the year number. For example volume 119 can be distinguished from the other 1954 volume of *Science* by the modified year number –54.9 (see Table 1). An issue number could be specified by appending a second number, if it were necessary.

How the system could be put into effect. The new-style citations can be adopted immediately on an informal basis by any editor, author, literature searcher, or librarian who will compile his own list of perhaps 1 to 3 dozen journal codes. For the occasional uncoded journal, the conventional abbreviation can be sandwiched between the page and year numbers in place of the code letters. Individual scientists should find such citations handy for literature notes and bibliographies.

Ultimately a comprehensive journal code list sponsored by appropriate authorities would be desirable (*cf.* list in 1951 annual index of *Chemical Abstracts*).

Table 3. Suggested initial code letters designating country or continent of publication (remaining letters reserved for future allocation).

Continent or country	Code letters
North America	**M**
U.S.A.	**A, U**
South America	**W**
Brazil	**Z**
Argentina	**V**
Europe	**E**
Great Britain, Eire	**B**
Germany, Austria	**D**
France	**F**
Switzerland (Helvetia)	**H**
U.S.S.R.	**R**
Italy	**T**
Asia	**K**
Africa	**Y**
Australia	**S**

However, it should be emphasized that the number of journals *frequently* consulted by an individual scientist is not likely to exceed 2 or 3 dozen. Most of the code letters for these journals would soon be memorized, so that it would seldom be necessary to consult a comprehensive list. Then, too, the use of code letters might in time be greatly facilitated if the official code for each journal were included on its pages and covers and if short tables of journal codes for each particular field were made available.

The new-style citations would be especially suitable for use with automatic sorting devices for punched cards and microcards. Microcard libraries might ultimately be mechanized so that "dialing" the citation symbols on a modified telephone dial would cause the desired page or pages to be projected on a screen.

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14 May 1954.

A Technique for Making Multiple-Bore Microelectrodes

In electrobiological work, it is often convenient to use two or more electrodes separated by a known, small distance. This communication describes a method of making what is in effect a glass pipette with multiple bores. With the several bores filled with a metallic or electrolytic conductor, the pipette becomes a relatively rugged electrode assembly. The number of bores in the pipette can be at least as many as seven, and the spacing between bores at the tip of the pipette can be made as small as 10 μ and probably less.

The method is that of Elson (*1*), who used it to produce multiple-bore capillary tubes. A number of Pyrex tubes about 20 cm in length are packed snugly inside a larger Pyrex tube of similar length. This bundle is then treated as a single tube; any technique that will produce a single-bore microelectrode will, with slight modification, yield a multiple-bore microelectrode. During the drawing, the individual bores (and interstices between tubes) remain open, although the relative proportion of walls and bores is somewhat altered.

The drawing technique used in this laboratory is perhaps worth brief description since it requires only simple apparatus and very little manipulative skill. The drawing is done in three steps, the glass being cooled between drawings. In the first step, the original bundle is heated by an oxygen and gas flame and drawn down to about 1 mm in diameter. The piece is then divided near the center of the reduced portion, and a small, solid knob is formed at the tip of each resulting piece; the knob is to facilitate attachment of the weights that are used in the last two stages of drawing.

For the second drawing, the tapered bundle from the first step is supported in a vertical position with the small part pointing downward. A coil of No. 24 Nichrome wire of inside diameter 3 mm and length 5 mm is slipped over the tip and raised until it surrounds the portion of the tapered, multiple-bore tube, which is 2 mm in diameter. A weight of about 25 g is attached to the tip of the piece by an alligator clip. The nichrome coil is heated by current supplied through a variac and a step-down transformer. The coil temperature is regulated so that the glass is slowly drawn out. When an elongation of about 6 mm has been produced, the current is turned off; the glass is not allowed to break. It is advisable to place a small shelf beneath the weight to stop the drawing when the desired elongation has been accomplished. The coil is then lowered 2 or 3 mm until it is centered on the necked-down portion of the glass.

For the third stage of drawing, a heavier weight is attached, the size of which determines the final tip diameter. The coil is heated to a dull red and the glass is allowed to break, after which the current is turned off. The piece that breaks off can be conveniently examined under the microscope.

Since the final tip diameter depends upon several variables, no precise statement can be made regarding the amount of weight to be used in the third stage. The usable range is about 50 to 900 g, corresponding very approximately to 10 and 150 μ, respectively. For a given set of conditions, the tip diameter is reproducible to about 10 percent.

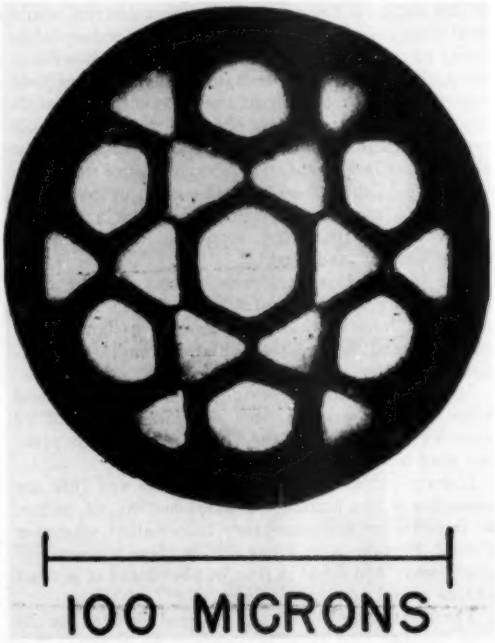

Fig. 1. Photomicrograph of the tip of a multiple-bore glass pipette having one central bore and six others arranged symmetrically around it.

Figure 1 is a photomicrograph of the tip of a multiple-bore electrode that is currently in use in these laboratories. It was made by packing seven pieces of 3-mm o.d. tubing inside a 9.6-mm i.d. tube. A diametrically opposite pair of bores is used to form salt bridges to silver-silver chloride electrodes inserted into the large ends of the bores. It is also possible to fill two or more of the bores with indium-tin alloy following the technique of Dowben and Rose (*2*).

VINCENT A. VIS

Department of Physiology,
University of Michigan, Ann Arbor

References

1. L. Elson, *J. of Sci. Inst.* **30**, 140 (1953).
2. R. M. Dowben and J. E. Rose, *Science* **118**, 22 (1953).

24 May 1954.

Anxiety Reduction as a Measure of the Analgesic Effectiveness of Drugs

A method that shows considerable promise for testing the analgesic potency of drugs has been developed recently at this laboratory. Previous techniques involving animals have been dependent upon measuring drug-produced changes in reflexes or unconditioned responses. In contrast with these techniques, the present method provides a testing situation more analogous to that found in the clinic, because it is based upon a psychological principle that has been validated on man.

Previous studies of this series were designed to test the hypothesis that one necessary action of a potent analgesic is the reduction of anxiety associated with anticipation of pain [H. E. Hill *et al., Arch. Neurol. Psychiat.* 67, 612 (1952)]. These investigations on man demonstrated that therapeutic doses of morphine (15 mg) significantly reduce behavior-disrupting anticipatory responses to painful stimuli. However, these techniques are not practical for the routine testing of drugs, since they are severely penalizing and utilize relatively large numbers of human subjects. It appeared possible, however, to develop a similar method for use with the laboratory rat.

Albino rats, maintained at approximately 70 percent of satiation weight, were conditioned to press a bar at a rapid rate in a modified Skinner Box. Food pellet reinforcements were available aperiodically at approximately 2-min intervals. Bar-pressings were recorded cumulatively on a slowly moving kymograph for the 20-min period of each test. After approximately 15 daily sessions, when the animals showed a high degree of conditioning, a 60-cy/sec tone was introduced 10 min after each test was begun. The tone was of 4 min duration and was terminated by a strong electric shock delivered to the rat through the grid floor. This superimposed, classical conditioning procedure reduced bar-pressing during the tone to a mean of 11 percent of the pretone rates. Subcutaneous injections of morphine, 4 to 11 mg/kg, spaced at weekly intervals restored the inhibited bar-pressing to 22 to 80 percent of the response rate exhibited prior to the tone. The effect varied directly with the dose, despite some over-all decrease in frequency of response.

In general, then, after the animals were thoroughly conditioned, bar-pressing was disrupted or completely inhibited for the duration of the tone. This anticipatory effect of painful stimuli was reduced by morphine with the result that the animals continued to press the bar during the tone. The results are analogous to those of the earlier studies on human subjects and support the hypothesis that reduction of anxiety associated with anticipation of pain is one necessary action of a potent analgesic.

The usefulness of this technique for testing the analgesic properties of a wide range of drugs is currently under investigation. In contrast with other techniques in which animals are used, this method would appear to be more closely related to those employed in the clinic, since anxiety is an important component of clinical pain. Furthermore, several uncontrolled variables that are present in clinical investigations, such as suggestion and personal interaction, would be eliminated. In addition, the method might be used by pharmaceutical houses and in other settings in which clinical studies are not possible.

HARRIS E. HILL
RICHARD E. BELLEVILLE
ABRAHAM WIKLER

NIMH Addiction Research Center
U.S. Public Health Service Hospital
Lexington, Kentucky

18 January 1954.

Whenever you look at a piece of work and you think the fellow was crazy, then you want to pay some attention to that. One of you is likely to be, and you had better find out which one it is. It makes an awful lot of difference.—CHARLES F. KETTERING.

Association Affairs

Society and Section Headquarters in Berkeley

Raymond L. Taylor

Associate Administrative Secretary

In the advertising portion of this issue is a two-page spread on (i) when advance copies of the 1954 General Program-Directory will be available; and (ii) sleeping accommodations at this year's Berkeley meeting of the Association. The first has a coupon usable by both advance registrants and those who are not planning to attend but would like this book of some 352 pages primarily for its directory content.

The other page announces an unusual variety of sleeping facilities and has an accompanying room reservation coupon with two added questions (pertinent this year) and a request for a small hotel room deposit (customary in California).

With the initial appearance of these two pages, to assist in choosing accommodations, it has been customary to announce the hotels that will be the headquarters of the AAAS, of the sections, and of the participating societies. At Berkeley, however, because the University dormitories will house portions of the memberships of most of the societies, and also because of the size of the hotels, it would have been inexpedient to attempt any formal assignment of headquarters hotels for the societies or groups of related sciences. Societies and sections, of course, will have their own session rooms, assigned for maximum convenience to similar programs; societies that wish them will have headquarters *rooms* on or off campus; finally, groups of society members who wish to room close together may do so by booking reservations accordingly and applying early. By use of the Visible Directory of Registrants in the Gymnasium for Men, the adjacent bulletin board and telephone, it will be possible to locate all registrants quickly and to leave messages.

Although none of the hotels is large enough to serve exclusively as the headquarters, for example, of the statisticians, physicists, astronomers, biologists, psychologists, the medical groups, or the science teachers, the housing accommodations are ample in total quantity and variety. There are attractive twin-bedded dormitory rooms with maid service—primarily for students, younger faculty members, and others not on expense accounts—at $2 each person the first night, $1 per night thereafter; rooms without private bath at International House for $2.50, and at the hotels for $2 to $3; and moderate-priced rooms with bath in excellent hotels and motels. The top price in suites is $20 per day for rooms overlooking the Golden Gate—not particularly expensive if occupied by four persons. The dormitories will serve breakfast "in"; the hotels serve all meals; and most motels serve no meals.

The Hotel Shattuck will be AAAS headquarters.

Coupon for Housing Reservations

Some further comments should perhaps be made.

1) *All* housing will be cleared through the AAAS Housing Bureau, operated by the efficient Convention Bureau.

2) Since all rooms are assigned in order of receipt, the date of application is important.

3) In general, single rooms at single rates are relatively scarce in any hotel in any city. When the supply of these is exhausted, only double rooms can be offered for single occupancy—at higher (although not double) rates. Thus, it conserves rooms, saves money, and is more sociable when two or more persons share a large room with individual beds. It is hoped that many will do this. One person may book an entire block of rooms, provided that he advances the deposits for all persons.

4) The deposit of $5 per person or $10 per hotel or motel room—which does *not* apply to dormitory rooms—is customary in California. It is refundable if the accommodation is canceled more than 10 days before the meeting—and usually later, if the room can be assigned to someone else—and, for those who stay only one night, any excess of deposit is refunded.

5) The space in which to name one's society or sectional interest is important. Within the choices and price range indicated, members of the same society or section will be assigned nearby rooms.

6) Those who drive to the meeting should say so. The campus of the University of California at Berkeley is compact, so that the dormitories, the Hotels Durant and Shattuck, and other accommodations are all within moderate walking distance of the center of the meeting—the Gymnasium for Men, the buildings housing the sessions, the University cafeterias, and several off-campus restaurants. But there are other comfortable hotels and motels within the city limits for which a car is needed. Those who will have an automobile at the meeting can be assigned to these motels or hotels. There will be adequate automobile parking facilities on the campus for those attending the meeting.

Headquarters Rooms

Statisticians, 288 Dwinelle; Physicists, 375 LeConte; Herpetologists League, 3598 Life Sciences Building; Western Society of Naturalists, 2507 Life Sciences Building; Society of Systematic Zoology, Stephens Memorial Room. Others will be announced later.

Meetings & Conferences

August

24–28. Potato Assoc. of America, Estes Park, Colo. (R. L. Hougas, Dept. of Genetics, Univ. of Wisconsin, Madison.)

25–27. American Phytopathological Soc., annual, Estes Park, Colo. (G. S. Pound, Dept. of Plant Pathology, Univ. of Wisconsin, Madison.)

25–27. Biological Photographic Assoc., 24th annual, Atlantic City, N.J. (A. F. Hancock, Photo Unit, Jefferson Hospital, 1020 Sansom St., Philadelphia 7.)

25–27. Western Electronics Show and Convention, Los Angeles, Calif. (M. Mobley, Jr., 344 N. LaBrea Ave., Los Angeles 36.)

25–3. International Union for the Protection of Nature, 4th, Copenhagen, Denmark. (H. J. Coolidge, National Research Council, Washington 25, D.C.)

27–28. Minnesota Acad. of Science, Itasca State Park, Minn. (B. O. Krogstad, Dept. of Biology, St. Olaf College, Northfield, Minn.)

28–29. Soc. for Social Responsibility in Science, annual, Yellow Springs, Ohio. (SSRS Office, Gambier, Ohio.)

30–31. Mathematical Assoc. of America, 35th summer, Laramie, Wyo. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

30–1. American Soybean Assoc., 34th annual, Memphis, Tenn. (G. M. Strayer, ASA office, Hudson, Iowa.)

30–1. Symposium on Vegetative Neurology, 5th, Vienna, Austria. (E. Anderson, National Institutes of Health, Bethesda, Md.)

30–3. International Soc. of Orthopedic Surgery and Traumatology, 6th, Bern, Switzerland. (M. Dubois, Isle-Hospital, Bern.)

30–3. International Symposium on Combustion, 5th, Pittsburgh, Pa. (B. Lewis, Alcoa Bldg., Pittsburgh 19.)

30–9. International Mathematical Cong., Amsterdam and The Hague, Netherlands. (M. H. Stone, Dept. of Mathematics, Univ. of Chicago, Chicago 37, Ill.)

31–3. American Mathematical Soc., summer, Laramie, Wyo. (E. G. Begle, AMS, Yale Univ., New Haven, Conn.)

31–10. UN World Population Conf., Rome, Italy. (J. D. Durand, Room 3025B, UN Bldg., New York.)

31–10. World Population Cong., Rome, Italy. (F. Lorimer, American Univ., Washington 16, D.C.)

September

1–7. International Soc. for Cell Biology, 8th, Leiden, Netherlands. (W. H. K. Karstans, Botanical Laboratory, State University, Nonnensteig 3, Leiden.)

1–8. British Assoc. for the Advancement of Science, annual, Oxford, England. (Sec., BAAS, Burlington House, London, W.1.)

1–8. International Cytological Cong., Leiden, Netherlands. (P. G. Gaillard, Histologisch Laboratorium, Rijksuniversiteit, Leiden.)

1–11 International Committee of Electrochemical Thermodynamics and Kinetics, 6th annual, Paris and Poitiers, France. (P. Van Rysselberghe, Dept. of Chemistry, Univ. of Oregon, Eugene.)

1–16. International Electrotechnical Commission, 50th, Philadelphia, Pa. (U.S. Committee, American Standards Assoc., 70 E. 45 St., New York 17.)

2–9. International Cong. of Mathematicians, annual, Amsterdam, Netherlands. (Sec., 2d Boerhaavestraat 49, Amsterdam.)

(See issue of 16 July for more comprehensive listings.)

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The General Program-Directory of the 121st Meeting of the AAAS on the campus of the University of California, Berkeley, Dec. 26–31, 1954, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The three-part General Symposium: "Science and Society."
2. Programs of the 18 AAAS sections (symposia and contributed papers).
3. Programs of the more than 70 participating societies.
4. The Special Sessions: AAAS, Academy Conference, Third Berkeley Symposium on Mathematical Statistics and Probability, Conference on Scientific Editorial Problems, National Geographic Society, Pacific Science Board, Phi Beta Kappa, Phi Kappa Phi, RESA, Sigma Xi.
5. Details of the Gymnasium for Men—center of the Meeting—and campus.
6. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
7. Exhibitors in the 1954 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1954.
2. Complete roll of AAAS presidents and their fields.
3. The 260 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS—through 1958.

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SLEEPING ACCOMMODATIONS AT 121st AAAS MEETING

Berkeley, California, December 26-31, 1954

The hotel, motel, and dormitory sleeping accommodations—their rates and the application coupon below—are for your convenience in making room reservations in Berkeley. Please send your application *directly* to the AAAS Housing Bureau and thereby avoid delay and confusion. The experienced Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **Single rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival and also probable date of departure.

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Shattuck	5.00–10.00	7.00–10.00	7.50–10.00	10.00–18.00
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(Note: Most hotels have singles without private bath at $2.00–$3.50 per night)

MOTELS				FAMILY ROOMS
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International House: Singles only, *without private bath*, $2.50 per night.

For a discussion of the headquarters of the participating societies and sections, please see Association Affairs, *Science*, July 23, or *The Scientific Monthly*, August.

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(State name of hotel, motel, or other)

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..... Double-bedded Room — Desired Rate ..... — Maximum Rate .....
..... Twin-bedded Room — Desired Rate ..... — Maximum Rate .....
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Make checks payable to "AAAS Housing Bureau."

The name and address of each person, including yourself, must be listed. Attach list if this space is insufficient.

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(Street) (City and Zone) (State)

My society (or sectional interest) is: .....

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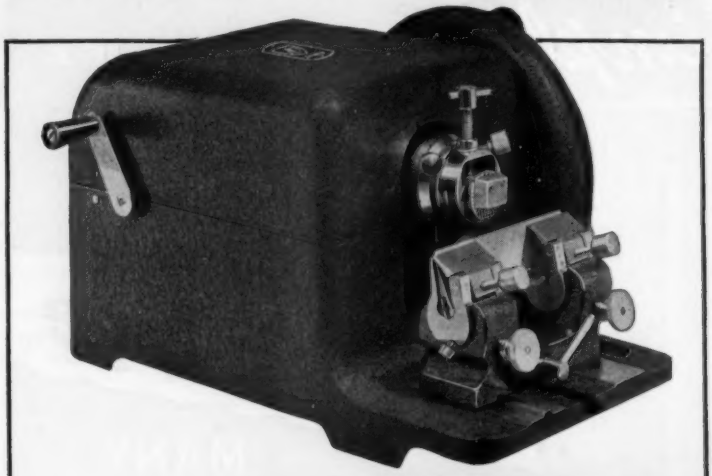

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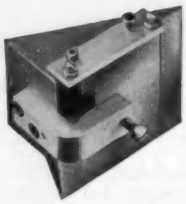

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